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Editorial Board

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THE PHYSICAL GROWTH OF ALABAMA WHITE GIRLS ATTENDING WPA PRESCHOOLS

FAIRYE C. WISE AND HOWARD V. MEREDITH[1]

Purpose

The present investigation was undertaken to ascertain information on the body size and form of white females in attendance at WPA Nursery Schools and WPA Preschools or Play Centers in Alabama.

In the past, research on the physical growth of young children has been done largely on groups representing the artisan, managerial, and professional classes. Often the samples have been drawn from private schools. The present study reports findings for children from decidedly impoverished socio-economic groups.

Again, numerous investigations have been made on the growth of children in the northeastern and northcentral states, and several are available for the western area. The present study was made in the southeast (Alabama), a region for which research on the physical growth of young children is practically non-existent.

The specific aims of this study were:

1. To obtain central tendency values at 2, 3, 4, and 5 years of age for each of fifteen body measurements on white girls attending WPA preschools in Alabama.[2]
2. To align these findings for body size with methodologically comparable findings on white girls of higher socio-economic status.
3. To present central tendency values describing the body form of Alabama WPA preschool girls and compare these with values for girls representing a higher socio-economic level.

Subjects

The subjects were 92 Alabama white girls, varying in age between 1 year 9 months and 5 years 3 months. They were enrolled at 7 WPA nursery schools and 4 WPA preschools located in small communities near Birmingham, Alabama, and at one Community Chest day nursery within the city limits of Birmingham.

Information was secured covering date of birth, place of birth of parents and grandparents, occupation of father, approximate annual income, and length of time in school. In this connection acknowledgment is made to the teachers and supervisors of the schools, the parents, and the staff of the Department of Public Welfare.

Information on birthplace of parents and grandparents was not obtainable for all cases. Place of birth of parents was available for 68 per cent of the subjects, and of grandparents for 45 per cent. Analysis of these data gave the following:

[1] *From the Iowa Child Welfare Research Station, University of Iowa, Iowa City, Iowa.*

[2] *In the interest of brevity, the entire group of schools studied will be referred to as WPA preschools.*

1. All parents and grandparents were born in North America.
2. For 57 per cent of the subjects both parents were born in Alabama, while for 90 per cent both were born in the southeastern region of the United States.
3. For 39 per cent of the subjects all 4 grandparents were born in Alabama, while for 88 per cent all 4 were born in southeastern states.

Socio-economic status was appraised by analyzing information on occupation of father, annual family income and, for those employed by WPA or receiving direct relief, length of time on relief. Data on father's occupation and family income were secured for every case. The former showed 30 per cent of the fathers were recipients of direct relief or certified WPA employees, 33 per cent were employed as laborers, 19 per cent classified as skilled trade employees, and 18 per cent fell among the commercial, professional and managerial groups. Annual income ranged from $144 to $1200, with 19 per cent of the families receiving less than $500 per year and 68 per cent receiving between $500 and $1000 per year. The mean family income was $670, or about $56 per month. Of the families certified for relief or WPA employment, 50 per cent had been in these categories for upwards of two and one-half years.

It was considered tenable that children of the same cultural and economic level as those utilized, but not in attendance at a preschool or day nursery, might show differences in physical growth resulting from the absence of certain items characteristic of the school environment. Hence, the sample was described with reference to selected features, possibly differential, not ordinarily found in the home environment of children of such low status.

	Nursery Schools	Pre-schools	Day Nursery
Mid-day meal at school planned by trained dietitian	Yes	No	Yes
Cod liver oil - at least 1 teaspoonful daily except in summer	Yes	No	Yes
One-half cup fruit juice or milk daily at mid-morning or mid-afternoon	Yes	Yes	Yes
Short mid-morning rest period	Yes	Yes	Yes
Afternoon period or sleep	Yes	No	Yes

The degree to which any of these factors in the school environment influence the child's physical growth would probably be a function of the length of time the child had been in attendance at school. Twenty-five per cent of the subjects studied had been in attendance less than 6 months, 40 per cent between 6 months and 1 year, and the remaining 35 per cent between 1 and 3 years.

In summary, the subjects may be characterized as 92 normal white girls, highly homogenous for geographic region and ethnic derivation, and drawn predominantly from low socio-economic groups.

Distribution of the subjects for age yields the following:

Age (years)	Number of subjects
1.75 to 2.25	25
2.75 to 3.25	20
3.75 to 4.25	24
4.75 to 5.25	23

Obviously, the midpoints of the 4 age groups are 2, 3, 4, and 5 years respectively.

Data

The data were collected between December, 1939, and August, 1941. They consist of 92 values for each of 15 anthropometric measurements. The measurements were taken according to the technique in current use at the Iowa Child Welfare Research Station and recently described by Knott (2). All observations were made with the subject nude and in an erect position. The instrument scales were read to the nearest millimeter for 14 dimensions of the body and to the nearest pound for weight. Specifically, the measurements taken on each subject were weight; stature; sitting height; bi-iliocristal width of hips; biacromial width of shoulders; width, depth and circumference of thorax at the level of the xiphi-gladiolus junction; circumference of abdomen through the umbilicus; maximum arm girth below the insertion of the deltoid muscle; leg girth at the level of greatest cross-section in the calf region; and thickness of the skin and subcutaneous tissue over the abdomen, at the posterior of the thorax, and on the back of the arm. These measurements total 14. Analyses are presented for 15. The values for one dimension, length of lower extremities, were derived as stature minus sitting height.

Findings on Body Size

The data were subgrouped into 60 series of values - one series each for 15 dimensions at four age intervals. Table 1 gives the arithmetic mean of each series and reproduces the minimum and maximum records.

In order to more adequately portray the form of the central tendency trend for each dimension, curves were plotted using mean magnitude as ordinate and age as abscissa. Inspection of these curves, supplemented by verification from Table 1, yields the following findings:

1. Weight, stature, sitting height, length of lower extremities, shoulder width, transverse diameter of thorax, and hip width show fairly regular increments over the full period from 2 to 5 years.

2. Each of the circumferences - arm, leg, chest, and abdomen - registers a marked difference between the means at 2 and 3 years, little difference in means between 3 and 4 years, and a marked difference again between 4 and 5 years. It is probable, of course, that this tendency toward a plateau between 3 and 4 merely reflects sampling fluctuation.

3. Means for the thickness of skin and subcutaneous tissue over the abdomen and at the rear of the thorax show a decline from 2 to 4 years and a rise at 5 years. Thickness at the back of the arm is greatest at

TABLE 1

BODY SIZE: Means, together with minimum and maximum values, for 15 anthropometric measurements at each of four ages. Subjects: Alabama white girls in attendance at WPA Preschools 1939-1941.

Midpoint of Age Groups (yrs.):	Two		Three		Four		Five	
Number of Cases:	25		20		24		23	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Stature (cm.):	85.1	78.6-90.4	92.4	84.2-99.0	99.9	92.2-109.7	105.6	94.0-115.9
Sitting Height:	51.3	48.0-55.5	53.9	50.4-57.0	57.4	52.4-61.4	59.6	53.8-64.3
Lower Limb Length:	33.8	29.4-40.4	38.5	33.8-42.3	42.5	38.4-49.1	45.9	40.2-52.9
Shoulder Width:	19.7	17.3-21.3	21.3	19.4-22.7	22.2	20.4-24.4	23.4	20.8-25.8
Hip Width:	14.5	13.3-15.5	15.8	14.6-16.9	16.4	14.9-18.1	17.2	15.6-19.1
Chest Girth:	49.2	45.3-52.6	51.0	48.2-53.7	51.6	47.4-55.7	53.4	49.4-57.8
Abdomen Girth:	49.7	46.0-51.8	51.2	47.3-53.9	51.6	46.7-55.3	53.0	47.8-58.6
Chest Width:	16.9	15.6-18.3	17.6	16.8-18.9	18.0	16.5-19.2	18.7	16.8-20.1
Chest Depth:	12.9	11.0-14.1	13.1	11.8-13.9	13.3	11.9-14.4	13.8	12.4-15.5
Arm Girth:	15.4	13.3-16.9	16.2	14.3-17.8	16.1	14.2-18.5	16.6	14.3-18.5
Leg Girth:	19.6	17.1-22.2	20.8	18.5-22.5	21.0	18.5-23.1	21.6	19.0-24.0
Weight (kg.):	12.3	9.3-15.0	14.3	12.3-15.9	15.7	13.2-18.1	17.7	13.6-23.1
Thickness of skin and subcutaneous tissue (mm.):								
Over abdomen:	5.0	3.0-7.5	4.9	4.0-7.0	4.5	2.5-6.5	5.3	3.5-7.5
At arm back	7.0	5.0-9.0	7.4	5.5-9.0	6.9	5.0-10.0	7.1	5.0-9.0
At chest back	4.4	2.5-6.5	4.1	3.0-5.5	3.6	2.5-5.5	4.1	2.5-6.5

3 years, least at 4 years and similar at 2 and 5 years. It is interesting that the lowest mean for all three determinations of tissue thickness is at 4 years — the age of relatively low means for the girth measurements.

One of the aims of the study was to compare the body dimensions of Alabama WPA preschool children with anthropometrically identical data on white girls of higher socio-economic status. For this purpose records were available on two independent groups of American-born white girls of North European ancestry in attendance at the University of Iowa Preschool Laboratories during the years 1938 through 1941. One group consisted of 34 children between the ages of 2 years 9 months and 3 years 3 months, the other of 50 children between 4 years 9 months and 5 years 3 months. Of these 84 Iowa City girls, approximately one-third represented the managerial or commercial groups and two-thirds the professional classes.

The known similarities and differences between the Alabama and Iowa samples may be epitomized as follows: Both are rigorously comparable for anthropometric technique, age-group limits, and statistical procedure; the time during which the data of each were collected is practically identical; the sex is the same for both; the ethnic derivations are similar -- although allowance should be made for a possible slight difference due to what might be termed the tendency of subgroups within the broad designation of North European ancestry toward lineal homogeneity; the geographic locations differ — however, research to date would credit little, if any, of a differential finding between Alabama and Iowa to "climatological and meterological effect" (4); and, finally, there is the unequivocal difference in socio-economic status — the Iowa sample representing a superior cultural level obtained through a private preschool, and the Alabama sample a low income group drawn from WPA preschools.

Table 2 presents the means for each sample at 3 and 5 years, together with results from an analysis of the differences at each age. It is found:

1. With the exceptions of girths of thorax and abdomen at 3 years and depth of thorax at 3 and 5 years, all means are smaller for the Alabama groups than for the Iowa groups. Compared with means from the literature for children of high socio-economic status, the Alabama means are lower by a minimum of (a) 3.0 cm. for stature and 0.4 kg. for weight in studies by Gray and Ayres (1), Simmons and Todd (7), and Wallis (8) and (b) 1.0 cm. in biacromial diameter and 0.3 cm. in bi-iliocristal diameter for the studies by Gray and Ayres and by Wallis.

2. The differences between corresponding means are greater at 5 years than at 3 years for all measurements other than the thoracic dimensions and the composite measure of thickness of skin and subcutaneous tissue. This tendency toward divergence with increasing age is also obtained from alignment of the Alabama means with other means representing the higher socio-economic groups. On the average, the studies of Gray and Ayres, Simmons and Todd, and Wallis yield means for stature higher by 3.5 cm. at 3 years and 4.8 cm. at 5 years and, for weight, higher by 0.5 kg. at 3 years and 1.5 kg. at 5 years.

3. At 3 years of age, differences statistically significant at the one per cent level of confidence (t values greater than 2.6) are obtained

TABLE 2

BODY SIZE: Means, differences between means, and t values for 13 measures on Alabama WPA preschool girls and girls at University of Iowa Preschool Laboratories.

	Three Years				Five Years			
	Alabama mean	Iowa mean	Alabama mean minus Iowa mean	t	Alabama mean	Iowa mean	Alabama mean minus Iowa mean	t
Stature (cm.):	92.41	95.74	-3.33	3.3	105.56	110.52	-4.96	4.1
Sitting Height:	53.93	55.94	-2.01	3.2	59.61	61.96	-2.35	4.0
Lower Limb Length:	38.48	39.80	-1.32	2.4	45.94	48.56	-2.62	3.7
Shoulder Width:	21.34	21.87	-0.53	2.0	23.41	24.59	-1.18	4.2
Hip Width:	15.80	16.10	-0.30	1.6	17.24	17.86	-0.62	2.5
Chest Girth:	51.02	50.43	+0.59	1.3	53.38	53.64	-0.26	0.4
Abdomen Girth:	51.22	50.92	+0.30	0.5	53.02	54.31	-1.29	1.5
Chest Width:	17.64	17.83	-0.19		18.68	18.80	-0.12	
Chest Depth:	13.10	12.94	+0.16		13.77	13.69	+0.08	
Arm Girth:	16.22	16.62	-0.40	1.3	16.60	17.49	-0.89	2.7
Leg Girth:	20.79	21.15	-0.36	1.2	21.61	23.47	-1.86	4.9
Weight (kg.):	14.27	14.67	-0.40	1.1	17.66	19.40	-1.74	2.8
Sum of three measurements of thickness of skin and subcutaneous tissue (mm.):	16.35	17.52	-1.17	1.4	16.52	16.99	-0.47	0.5
Number of cases:	20	34			23	50		

For fifty degrees of freedom, t must exceed 2.6 to indicate statistical significance at the one per cent level of confidence, and be not less than 2.0 for significance at the five per cent confidence level.

for stature and sitting height. At 5 years, statistically significant differences are indicated for stature, sitting height, length of lower extremities, shoulder width, arm girth, leg girth, and weight.

Findings on Body Form

As media in describing selected characteristics of the body form of WPA preschool children, the following indices were calculated:

1. The Skelic Index -- length of lower extremities (derived as stature minus sitting height) in percentage of sitting height.
2. The Thorax/Abdomen Index -- thoracic circumference at the level of the xiphi-gladiolus junction in percentage of girth of the abdomen at the level of the umbilicus.
3. The Hip/Stem Index -- bi-iliocristal diameter in percentage of sitting height.
4. The Thoracic Index -- transverse diameter of the thorax in percentage of antero-posterior diameter.

All of the components of these indices were available on every subject. Consequently, 92 values for each index were computed, distributed, and reduced. The results are given in Table 3.

TABLE 3

BODY FORM: Means, together with minimum and maximum values, for four anthropometric indices at each of four ages. Subjects: Alabama white girls in attendance at WPA preschools 1939-1941.

Midpoint of Age Group (yrs.):	Two	Three	Four	Five
Number of Cases:	25	20	24	23
Skelic Index:				
Mean	66.0	71.5	74.2	77.0
Range	55-84	66-77	69-81	70-84
Thorax/Abdomen Index:				
Mean	99.0	99.7	100.1	100.9
Range	94-105	96-106	96-106	94-108
Hip/Stem Index:				
Mean	28.3	29.3	28.6	28.9
Range	25-30	28-33	27-31	27-31
Thoracic Index:				
Mean	131.2	135.1	136.4	135.8
Range	120-147	128-150	128-151	125-152

Inspection of this table shows:

1. There is a steady increase in the mean skelic index from 66 at 2 years to 77 at 5 years. At age 3, individual cases give ratios of lower limb length to stem length as low as the mean for 2 years and as high as that for 5 years.
2. Relative to circumference of abdomen, circumference of thorax increases from 99 per cent at 2 years to 101 per cent at 5 years. In other words, mean abdomen girth exceeds mean chest girth at 2 years, the two girths are practically equal at 3 and 4 years, and the former is exceeded by the latter at 5 years. The zone of individual differences is

almost the same at all four ages.

3. Changes in the mean hip/stem index from age to age are neither large in amount nor consistent in direction. On the whole, bi-iliocristal width of hips appears best interpreted as fluctuating around 28.8 per cent of sitting height throughout the age period studied. Individual girls have ratios between 25 per cent and 33 per cent.

4. There is a marked increase in mean thoracic index between 2 and 3 years, a moderate increase between 3 and 4 years, and a slight decrease from 4 to 5 years. In general, breadth of thorax is found to approximate 131 per cent of thoracic depth at 2 years and 136 per cent at 5 years. Records for individual girls vary from widths less than 1¼ times depth (at 2 years) to widths upwards of 1½ times depth at 4 and 5 years.

As for body size, at ages 3 and 5 years it is possible to compare these body proportions of Alabama girls from WPA Preschools with corresponding figures for Iowa City girls typifying a moderately high socio-economic level. It is found:

1. For the Iowa City series already described, the mean skelic indices are 71.2 at 3 years (N=34) and 78.4 at 5 years (N=50). These values are reinforced by means of 71.2 (N=90) and 78.2 (N=195) respectively, reported (5) from an analysis of data collected 1929-36 on a similar sample of Iowa City girls. In conjunction with analogous means from Table 3, it follows that length of lower limbs relative to sitting height is practically the same for the Alabama and Iowa City groups at three years and, at 5 years, over one per cent less for the former than for the latter.

2. The means of the ratios of chest circumference to abdomen circumference, on the Iowa City data accumulated 1938-41, are 99.2 at 3 years (N=34) and 98.9 at 5 years (N=50). The negligible difference between these means contrasts with a difference of more than one per cent shown in Table 3 for the Alabama girls at 3 and 5 years. At 3 years the two socio-economic groups do not differ appreciably, while at 5 years chest girth tends to exceed abdomen girth in the impoverished group (mean index about 101) and to be less than abdomen girth in the privileged group (mean index approximately 99).

3. On the Iowa City data gathered 1938-41, means for bi-iliocristal diameter in percentage of sitting height are 28.8 at 3 and at 5 years. On comparable Iowa City data collected 1929-36 (3), the means for this index are 29.2 at 3 years (N=66) and 29.4 at 5 years (N=94). The Alabama means, as shown from Table 3, approximate the 1929-36 mean at 3 years and the 1938-41 mean at 5 years. Since the difference in results from the two Iowa City groups is seemingly a product of chance fluctuation in random sampling, the differences between means for the Iowa City and Alabama groups are considered lacking in morphologic significance.

4. The thoracic index means from the Iowa City materials, for 1938-41, are 137.9 at 3 years and 137.4 at 5 years, for 1929-36 (6), 130.7 at 3 years (N=71) and 136.4 at 5 years (N=109). The Alabama means are between these means at 3 years and below them at 5 years. Weisman (9) compared central tendency values for the thoracic index on school children from the best and poorest sections of Minneapolis. He found the typical child of the higher socio-economic classes to have a chest

slightly flatter relative to its breadth than the typical child of the lower classes. At 5 years of age --though not at 3 years-- the contour of the chest for our Alabama children of low status likewise registers a slight tendency to be deeper relative to width than the Iowa City children of markedly higher status.

Summary

The general purpose of this study was to describe the body size and form of a group of Alabama white girls in attendance at WPA Nursery Schools and Preschools during 1939-41. The specific objectives were, first, to make analyses for 15 measurements of size and four indices of form and, secondly, to align the results with rigorously comparable findings on Iowa white girls of decidedly higher socio-economic status.

The subjects were 92 Alabama white girls ranging in age from one year nine months to five years three months. They represented a definitely low socio-economic level. The series of anthropometric data taken on each girl consisted of stature; sitting height; length of lower extremities; bi-iliocristal and biacromial diameters; width, depth, and circumference of thorax; girth of abdomen, arm, and leg; weight; thickness of skin and subcutaneous tissue over the abdomen and at the posterior of the arm and the thorax.

For each of the 15 measurements, and for 4 anthropometric ratios, the data were distributed into 4 age groups with midpoints at successive years from 2 to 5. Tabular and graphic analyses gave the following findings for central tendency:

1. A steady increase from 2 to 5 years for weight, stature, sitting height, length of lower limbs, shoulder width, width of thorax, and hip width.

2. A fairly rapid increase except between 3 and 4 years for the 4 measurements of circumference. (The tendency toward a plateau between 3 and 4 may register nothing more than sampling fluctuation.)

3. A decline from 2 to 4 years and a rise at 5 years for thickness of skin and subcutaneous tissue over the abdomen and at the rear of the thorax. For each of the measures of tissue thickness, the lowest mean was at 4 years -- the age of smallest increase in the girth means.

4. A marked increase in the skelic and thoracic indices between 2 and 3 years. Length of lower extremities in percentage of sitting height showed a moderate rise from 3 to 5 years. Thoracic width in percentage of depth of thorax registered a moderate rise between 3 and 4 years and a slight decline from 4 to 5 years.

5. A small but steady increase from 2 to 5 years for chest circumference in percentage of girth of abdomen. No change in the hip width/sitting height index of appreciable magnitude or consistent direction.

At 3 and 5 years of age, the data on Alabama WPA preschool children were aligned with methodologically identical data on Iowa City children of markedly higher socio-economic status. The following comparative statements accrued:

1. With few exceptions, the means for body size on the Iowa groups exceeded those for the Alabama groups. The excess was upwards of three

centimeters in the case of stature.

2. The differences between the Iowa and Alabama samples tended to be larger at 5 years than at 3 years. Statistically significant differences at 5 years were obtained for stature, sitting height, length of lower limbs, shoulder width, arm girth, leg girth, and weight.

3. At 3 years, the two socio-economic groups did not differ appreciably in those aspects of body form subjected to study. At 5 years, compared with the Iowa sample, the Alabama sample gave a slightly smaller abdomen girth relative to chest girth, slightly shorter lower limbs relative to body stem, and a slightly deeper thorax relative to thoracic width.

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LANGUAGE DEVELOPMENT OF CHILDREN IN TWO DIFFERENT RURAL ENVIRONMENTS[1]

G. M. WORBOIS

Different environments may not provide equally stimulating conditions for the development of language ability of children. Two common environments in rural areas are those of the consolidated and the one-room school. The present study was designed to determine if consolidated school children develop more rapidly in certain language abilities than do the children of the same IQ and the same initial ability in one-room schools.

It is possible that the organization and administrative practices of some one-room schools provide the child with less opportunity for a functional use of language than do the conditions of other school environments. It is possible that the teachers, confronted with pupils of widely different ages, and several relatively well-defined groups, all of which vary in needs, are handicapped in providing adequate stimulation for language use. There may, in addition, be attitudes in some one-room schools which do not encourage verbalization of real and vivid experiences of the child.

Some indication of the development of language ability by consolidated and one-room school children is given in the study by Baldwin, Fillmore, and Hadley (1). They divided the items of the Stanford-Binet intelligence test into language and non-language items arbitrarily, and determined the total months credit for each. These totals were compared with expected months credit if the language and non-language items were passed equally frequently, and the chi-square test was applied. This test showed that the hypothesis of "no difference" may be rejected in both the case of the one-room school children and the consolidated school children at a high degree of confidence. In other words, it is relatively certain that these rural children failed a higher percentage of the language items than the non-language items. They found that the greatest deficiency was in the use of language in "a creative way." (p. 246f.)

Methods and Procedures

A rural area was selected in which was located a consolidated school surrounded by several one-room schools. Enough of the neighboring one-room schools were selected on the basis of proximity to the consolidated school so that there would be about an equal number of children at each age or grade level in the two groups. All the children were living within a small farming area (about 10 mile radius) of rich soil and favorable farming conditions. It was proposed to measure by repeated tests the development of these children over a relatively long interval. The technique used was the analysis of covariance, holding initial IQ and initial score constant, and evaluating differences on the final measure.

[1] *This study, from the Iowa Child Welfare Research Station, was directed by Dr. Ralph H. Ojemann.*

Stanford-Binet Vocabulary Test

The vocabulary item of Form L of the Stanford-Binet intelligence test was given to three groups: Group A, pupils having their first year of school attendance during either of the two years of the study; Group B, pupils having their first two years of school attendance; and Group C, pupils having their second and third years of attendance during the two years of the study. Tests were taken in the fall and the spring. Only those pupils were studied who had been in no other school environment, and who continued in the school for both measures.

Iowa Every-Pupil Tests

The Vocabulary and Language Skills sub-tests of the Iowa Every-Pupil Tests were given to the third and fourth grade pupils of the consolidated and one-room schools near the end of the first semester. A year later another form of the same test was given to the pupils who had taken the previous test and who were still in the school.

"Verbal Effectiveness Test"

An experimental situation was designed to test how effectively children could verbalize an experience. The prerequisites set down for the procedure were: 1) that it should contain only material and manipulations familiar to all the children, 2) that to verbalize the experience should require vocabulary and sentence structure well within the child's ability, and 3) that the expression of the child should be in such a form that its effectiveness could be evaluated objectively.

The situation designed required the child to string a set of beads varying in color, size, and shape. Six strings of beads were constructed consisting of the same colors, shapes, and sizes, but varying in combinations, each containing eight beads. These six sets of beads were shown to the subject, and he was given a box of beads and a string. The instructions were as follows:

> "Here are six strings of beads. I want you to make another string with these beads (pointing) just like one of these. It doesn't make any difference which one you make. You can make any one you want to. I am not going to see which one you make. You will have to tell me just which beads you put on so that I can make another one just like yours. Notice that the beads are different colors, different shapes, and different sizes." Ask S the name of each of the colors (yellow, red, pink, green, blue, and purple) on String No. 4. Ask, "Is this a big one or a small one?" for each of the different beads on String No. 1. Say, "Now look at this string (No. 6). Is this bead (pointing) long, flat, or round?" Say the same for the second bead. For the third and the other beads of this string say, "What shape is this one?" Hold up large, purple, round bead and say, "Now tell me what bead this is." If S omits size, shape, or color, say, "And what ____ is it?" Prompt S if no response or incorrect. Do the same for large, red, flat bead. Say, "Now make a string of beads like any one of those and let me know when you have finished." After S has finished say,"Now tell me what beads you put on your string

so I can put the same ones on mine. Remember the beads are different colors, different shapes, and different sizes."

After the experimenter was sure that the child understood the task and had told the child to make his string of beads, a screen was placed between the child and the experimenter on the table. When the child had said that he had made his set of beads and the experimenter had asked him to tell which beads he had put on the string, the recorder was started by means of a silent switch. The microphone was concealed, and the subject did not know that his speech was being recorded.

After the child had finished telling which beads he had strung, a picture was given to him with the request, "Look at this picture and tell me all about it." This picture was the "Dutch Home" in Form L, of the Stanford-Binet scale which appears at the III-6 year level. He was allowed 60 seconds to tell about this picture, during which time his speech was recorded.

The subjects for this experimental situation were selected from Group B, described above, and were matched on the basis of chronological age, IQ, and sex. The children had each had about a year and a half of school attendance and had previously had three individual intelligence examinations in the same testing conditions. Eight pairs resulted from this matching.

The score for verbalizing about stringing the beads was simply the number of beads correctly identified in the two groups. The score for verbalizing about the picture was the total number of words, and the number of different words used.

Results

"Verbal Effectiveness Test"

The children (8) in the consolidated school identified fully (i.e. gave size, shape, and color) a total of seventeen beads. Those in the one-room schools (8) identified fully only five beads. The difference is significant at the one per cent level of confidence according to the chi-square test ($\chi^2 = 6.6$). All of the subjects in the consolidated school group gave the color for all of the beads (64), whereas in the one-room school group the color was given for only 55 beads. This difference was significant at the one per cent level of confidence ($\chi^2 = 7.7$). The shape was given correctly for 38 of the beads by those in the consolidated school and for only 21 of the beads by those in the one-room schools. This difference is also significant at the one per cent level ($\chi^2 = 8.0$). In giving the size, only a small number in the case of both the consolidated and the one-room school group succeeded.

In response to the picture, the children in the consolidated school gave a mean of 72.8 words and those in the one-room schools gave a mean of 38.2 words. This difference is significant at the five per cent level of confidence according to the t-test of Fisher ($t = 2.7$). The children in the consolidated school used a mean of 31.4 different words and those in the one-room schools used a mean of 23.0 different words. This difference just misses being significant at the five per cent level ($t = 2.2$). The vocabulary, of course, in this kind of situation is largely confined to the objects of the picture.

Stanford-Binet Vocabulary

The children in the consolidated school (Group A) defined an average of 7.5 words of the Stanford-Binet vocabulary item at the end of their first year of school attendance. Those of the one-room schools defined an average of 5.7 words. The consolidated school children gained during the school year 1.2 words, or the equivalent of nearly a full year according to the norms of the test. Those in the one-room schools gained only 0.3 words. Holding the initial score and IQ constant by analysis of covariance, the difference at the end of the first year's attendance was significant at the one per cent level of confidence, as indicated by an F-value of 18.3 in Table 1. The children in the consolidated school were higher in initial vocabulary score than were those in the one-room schools, and the difference was significant at the five per cent level. They were also older by about five months. When difference in age was held constant, however, by analysis of covariance, differences in initial vocabulary scores were not significant.

TABLE 1

STANFORD-BINET VOCABULARY CHANGE FOR CHILDREN IN CONSOLIDATED AND ONE-ROOM SCHOOLS

	Consolidated			One-Room			F_t		
	N	M	σ	N	M	σ	F_o	(1%)	(5%)
Group A	34	7.5	1.50	30	5.7	1.72	18.3	7.1	4.0
Group B	16	8.3	1.26	14	6.5	1.80	6.8	7.7	4.2
Group C	13	8.7	1.26	11	7.4	1.49	4.7	8.1	4.4
Mean Initial IQ									
Group A		106			105				
Group B		105			104				
Group C		112			104				
Mean Initial Score									
Group A		6.3			5.4		5.6	7.1	4.0
Group B		6.1			5.5		1.3	7.7	4.2
Group C		7.6			7.1		xx	xx	xx

During the first two years of school attendance the subjects in Group B in the consolidated school gained an average of 2.2 words, while those in the one-room school gained an average of 1.0 words. The difference in final means, holding initial score and IQ constant, is significant between the one and five per cent levels of confidence. During their second and third years of school attendance the children in Group C in the consolidated school gained an average of 1.1 words while those in the one-room school gained an average of 0.3 words. This difference, holding initial score and IQ constant, is significant at the five per cent level of confidence.

Iowa Every-Pupil Tests

At the end of the first semester of the third and fourth grades the children in the consolidated school secured a mean score on the Vocabulary test of 45.7. A year later they secured a mean score of 58.6, or

a gain of 12.9. This is equivalent to about a year and three months of academic achievement. On the other hand, those in the one-room schools gained an average of 7.2 months. As indicated in Table 2, the difference between the consolidated school children and the one-room school children after one year's attendance is statistically significant at the one per cent level, holding initial score and IQ constant by analysis of covariance.

TABLE 2

CHANGES IN IOWA EVERY-PUPIL VOCABULARY AND LANGUAGE SKILLS TEST SCORES FOR CHILDREN IN THIRD AND FOURTH GRADES OF CONSOLIDATED AND ONE-ROOM SCHOOLS

	Consolidated	One-Room	Diff.	F_o	$F_t(1\%)$	$F_t(5\%)$
Vocabulary						
N	25	30				
M	58.6	44.8	13.8	7.4	7.2	4.0
σ	12.8	12.5				
Language Skills						
N	26	34				
M	59.9	44.0	15.9	4.6	7.1	4.0
σ	13.3	12.2				
Vocabulary						
Mean Initial IQ	110	100				
Mean Initial Score	45.7	37.6				
Language Skills						
Mean Initial IQ	111	100				
Mean Initial Score	48.0	34.8				

On the Iowa Every-Pupil Language Skills test the consolidated school children gained 11.9 months during the year of school attendance, while those in the one-room schools gained only 9.2 months, as indicated in Table 2. The difference after a year of attendance, holding initial score and IQ constant by analysis of covariance, is statistically significant at the five per cent level of confidence.

Summary and Discussion

The results of these three tests agree in showing higher scores for the consolidated school children. Furthermore, it appears that differences between the consolidated school children and the one-room school children are associated with attendance in these school environments.

Attempt was made by means of a short-time-sampling technique to find out if the activities of the teacher and of the pupils differed in important respects in these two school environments. Twenty-one three-minute samples of pupil and teacher activity taken simultaneously by two observers was found to give a per cent of agreement of 91. The results of these observations show that teachers in the one-room schools ask for and accept more often memorized, formal answers. This occurred in 59 per cent of the three-minute samples of teacher activity in the one-room schools, and in only 40 per cent of the samples of teacher activity in

the consolidated school. This difference was significant at the three per cent level of confidence ($\chi^2 = 4.95$). The pupils in the consolidated school read or otherwise used references (not immediate text) significantly more than those in the one-room school.

These differences in schoolroom activities are possibly of significance for the language development of children living in these two types of school environment. Possibly also of significance is the fact that the teachers in the one-room schools have had only an average of 0.6 years' education beyond high school, while those of the consolidated school have had an average of 3.0 years beyond high school ($t = 4.5$). On the other hand, the home environment of the children in the one-room schools appears to be similar to that of the children in the consolidated school, as judged from mid-parent education and occupational level. Measures of parents' attitudes toward the child and the school also showed the two groups to be similar.

The data of this study indicate that significant differences in the growth of language abilities appeared in the two rural environments considered in this investigation. They point to the importance of designing environments that provide for an enriched language development of rural children.

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THE EFFECT OF A LEARNING PROGRAM DESIGNED TO ASSIST YOUTH IN AN UNDERSTANDING OF BEHAVIOR AND ITS DEVELOPMENT

MILDRED I. MORGAN AND RALPH H. OJEMANN[1]

General observation as well as clinical analysis of youth problems tends to indicate that many problems arise from an inability to interpret the behavior of others. A young man or woman may resent a dominating father or mother. If the young person does not understand, for example, that one of the motives of domination by the parent may be insecurity on the part of the parent there is a tendency to consider the parent as an "opponent" rather than as one who is in need of help. Similarly, when a boy does not take a girl on a date there is a tendency for the girl to assume that there is something "wrong" with her instead of considering the many possibilities - the young man may feel inferior because he does not have enough money or he may feel that the girl is more experienced in social relations than himself and therefore he does not wish to expose his lack of knowledge.

It would seem helpful in making adjustments to have an understanding of human behavior as it occurs in family and social relationships including especially a knowledge of the many explanations that may underlie a given form of behavior, how various behavior patterns develop and how one can meet a situation when only an approximate indication of the real motive is available.

In this study a program was designed to develop an understanding of behavior as it occurs in marriage, family, social and selected economic relationships. This program was administered to two groups of subjects, one a group of young people in school and the other a group of out-of-school employed youth.

The general plan of the study consisted in selecting equated experimental and control groups; obtaining measures of selected attitudes and conflicts at the beginning of the experiment; administering the learning program to the experimental group and obtaining final measures. The duration of the experimental period from initial to final tests was approximately four months.

One of the experimental groups of the study consisted of 28 college students, 16 women and 12 men; the other, of 28 out-of-school youth, 15 women and 10 men. The same type of membership was represented in the corresponding control groups. The out-of-school employed subjects were recruited by staff members of Young Men and Young Women Christian Associations assisted by young people from their membership. The program was presented as an opportunity to discuss under leadership problems involved in family, marriage and economic adjustments.

Membership was entirely voluntary. This fact must be taken into account in describing the experimental groups. They represented groups already high in interest and in the realization of the importance of the problems to be considered. In the employed group a wide range of types of positions held was represented. A variety of social experience as to dating, engagements, et cetera, was represented in both the

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employed group and student group. The mean age for the student group was 20.4 years while that for the employed group was 21.0 years. For the employed group the mean educational level was slightly beyond four years of high school; the mean for the student group fell at the third year of college.

The comparisons of the experimental and control groups were made in the following areas: personality conflicts as measured by the Luria procedure and selected attitudes as measured by methods devised for this study.

The details of the Luria procedure including evidence as to its validity have been described elsewhere (1). In administering the Luria test the central processes were brought into play using a list of 100 words ordinarily associated with the four areas: home, companions of both sexes, school or work and general outlook on life. Conditions and directions for administering the tests were carefully worked out and applied. Measures were obtained of voluntary movements, involuntary movements, reaction time and verbal responses. The measures used in this study are the disturbances in voluntary movements and the proportion of verbal responses classified as indirect, egocentric and omitted.

The measurements of attitude were obtained as follows. Each subject in the experimental and control groups was asked to write answers to certain questions concerning himself. The questions on this report blank were designed to reveal rather indirectly the subject's attitude toward his home and family, his social relationships, his work, and toward what he felt was worth working and striving for in life. The questions were designed to approach each attitude from several angles. An informal interview was then held with each subject for two purposes: to obtain further information on the attitudes of the subject which would clarify anything not definite on the self-report blank and to establish rapport on the part of the subject and experimenter in preparation for the teaching program.

Data obtained from initial interviews and from the self-report blanks were translated into scale values on a seven-point scale. Data on the following attitudes were obtained:

1. Attitude toward parents.
   As illustrative of the extremes of this attitude a young person would be rated "1" if he seldom disagreed with his parents and turned to them with practically all of his decisions. He would be rated "7" if he rejected his parents giving them practically no credit for what he has become.
2. Rating as to social status with the opposite sex.
   The subject would be rated "1" if he stated that he doesn't rate at all with the opposite sex and feels this lack keenly and "7" if very popular, conscious of it and reveling in the fact.
3. Attitude toward place of sex in life.
   A rating "1" was given a person who feels sex to be base and seeks not to recognize that it has any place in life. At the opposite extreme is the young person who considers sex and its physical expression to be preeminent.

4. Attitude toward self-determined goals and standards.
   A rating of "1" implies uncritical or blind acceptance of institutional goals, of family, church or economic level; the other extreme "7" is one who rejects institutional goals.
5. Attitude toward social problems.
   The individual rating "1" reveals relatively little sympathetic interest in social problems or conditions. Self-interest seems paramount. A rating of "7" given to those subjects who were much concerned with social problems.

Reliability of Measuring Instruments

Reliability of Luria Scores

Using a split-half method without Spearman-Brown correction the following correlations on the initial tests between halves were obtained.

Measure	N	Original Correlations
	Student	
Voluntary disturbances	62	.82
Verbal scores	62	.85
	Employed Group	
Voluntary disturbances	58	.86
Verbal scores	58	.73

Reliability of Classifications of Verbal Responses

In previous investigations it was found that the classification of verbal responses as suggested by Jung is too detailed to obtain satisfactory reliability. While adhering to the major principles of Jung's scheme the major categories were simplified much as in the study by Ojemann and Grant (3). The definitions of the categories were carefully refined. Five hundred verbal responses were analyzed by two observers yielding a percentage of agreement of .88.

Reliability of Rating Scale for Attitudes

As indicated above data from the self-report blanks and initial interviews were translated into scale values on a seven-point scale. Data from 5 subjects selected at random were rated before and after the learning program on each of the 5 attitudes by 3 observers. The following table indicates reasonably satisfactory reliability.

Raters	Ratings before learning program	Ratings after learning program
A vs B	21 of the 25 possible ratings were in exact agreement or one step apart	23 of the 25 ratings were in exact agreement or one step apart
A vs C	19 of the 25 ratings in exact agreement or one step apart	22 of the 25 in exact agreement or one step apart

Validity of Luria Test

In connection with this study an analysis of the validity of the Luria procedure was made. This has been reported in a separate publication (1).

Description of Learning Program

The learning program consisted of an initial interview, eight group meetings taught by group discussion or seminar method, one joint meeting of the two experimental groups, together with assigned selected readings and an individual teaching conference. Examples of titles for the discussion meetings include:

Learning to live with one's family as an independent adult
Dating and courtship
Choice of mate and engagement
Marriage adjustments
Attitude toward work and money
Goals and standards

In designing the learning program it was recognized that much of the popular material in this field consists of platitudes and generalities, often without careful recognition of the limits of knowledge and the needs of the learner. From a careful analysis of basic data and problems as to the nature of the learner and the material to be learned, criteria for selecting learning experiences were devised and applied. Included in this list was the following:

> Changes in knowledge produced in the course of the learning program must be in accord with the available scientific evidence. An important part of each generalization is its probable error which clarifies the limits of our knowledge.

From the initial interviews some knowledge of the problems of the subjects was secured and as the program developed more indications were obtained. It was against this background of growing knowledge of the problems of the groups that the learning program was built.

For example, the chief concerns of the group relative to the parental family were whether or not the parent understood the necessity for self-direction on the part of the young person and allowed him increasingly to make his own decisions. If employed, there appeared the additional problem of dependent parents thus delaying marriage for youth. In this group, too, were those whose fathers were unemployed, and who because of unemployment had lost self-confidence, thus further complicating the family relationships. Some parents of the employed group, although not dependent, were very dictatorial regarding the child's earnings. This tended to produce frustration on the part of both parents and child.

All subjects showed some frustration regarding the lack of opportunity to meet members of the opposite sex; the high commercialization of recreation; and their own lack of originality and courage in creating

interesting things to do rather than following the accepted sophisticated social pattern of their respective communities.

Sex antagonism, showing resentment against attitudes and practices of the other sex, was expressed again and again in the course of the meetings. As each attitude emerged in the study group, the experimenter sought to integrate it into the learning process. Sometimes it was dealt with immediately; at other times it would be brought into the discussion at the following meeting when the group could be more objective about it, or the experimenter could bring to the group research material or illustrations which would help the group to see why such behavior occurs, or why certain points of view are held with such vehemence.

Again, not much time was spent on the discussion of money as a subject in itself, but it came up for discussion very often as a symbol of value or of power in family relationships or in the social relationships of men and women as well as in the total culture pattern of American living.

This was also true of a person's standards, scheme of values, or goals for living. The leader did not plan for an abstract discussion of standards and values but again and again in the discussion of specific problems such measuring rods as, "What would prove to be lastingly satisfying?" or "Does this matter consider only the self-interest of the individual or does it take into account the well-being of others?" were applied.

Very little consciousness of social and economic problems was found in either the employed or student group. Each subject was deeply concerned over his individual lack of economic security or vocational future, but the group as a whole seemed quite unaware of their individual problem being a part of the whole. There were individual exceptions of subjects who were deeply concerned over the whole social situation, but again, they were so far in advance of the thinking of most of the group that their contribution was not all it might have been.

The women, as a group, were even more unaware of social and economic problems than were the men. For the majority of them, marriage was their goal in life and along with marriage, a naive expectancy of economic security. Again, there were individual exceptions to this point of view.

A further indication of the nature of the learning program may be obtained by examining the goals which leader and group used as guides in their discussions. The goals were stated in terms of changes to be produced in the learner. In the discussion on The Family and Our Growth to Independent Adulthood for example, the goals were as follows:

a. To assist the group in the location of areas of tension most frequently found in family relationships of youth eighteen to twenty-five years of age.
b. To develop an understanding of the manifold possible causes underlying these tensions on the part of both youth and their parents.
c. To help youth to become aware of some of the possible effects on personality development of a long period of economic dependency such as is true for some students as well as the possible effects created by having to

assume financial responsibility for dependent parents at an early age necessary for some employed young persons.

d. To create a more favorable attitude toward seeking to understand causes of parental behavior rather than resorting to blame or conflict.

A detailed description of the learning program together with detailed records of class discussions, et cetera may be found in Morgan (2).

Quantitative Results

In analyzing the results of the initial and final test scores, the significance of the differences between means was tested by using "t" for the means of related measures. Each subject in the experimental group was paired with a subject in the control group using sex, the initial measure of the voluntary disturbances, and the verbal responses as the equating measures. The difference between the two means in the end test was then obtained and "t" of the difference used as a measure of significance.

The employed experimental and control groups were well matched on the initial test (Table 1) as indicated by a value of "t" for differences between means of voluntary disturbance scores equal to .51 and verbal scores equal to .57.

On the final test the difference between the employed experimental and control groups is significant well beyond the 1 per cent level (Table 1). It is to be noted that the differences are consistently high for both the voluntary disturbance scores ("t" 4.20) and the verbal scores ("t", 4.01). The value of "t" at the 1 per cent level of significance is 2.797.

TABLE 1

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL TESTS BETWEEN EXPERIMENTAL AND CONTROL GROUPS (EMPLOYED GROUP)

Measures	N	Means of Differences	Σd^2	"t"	"t" for 1% Level of Significance
			Initial Test		
Voluntary disturbances	25	.60	835	.51	2.797
Verbal scores	25	.72	954	.57	2.797
			Final Test		
Voluntary disturbances	25	23.16	18293	4.20	2.797
Verbal scores	25	15.48	8958	4.01	2.797

The analysis of the data from the student experimental and control groups shows that these groups, too, were evenly matched on initial test scores (Table 2) for both measures. For voluntary disturbances, the value of "t" is .12 while for verbal category measures, the value is .20.

In the final test (Table 2), "t" for significance of difference between voluntary disturbance scores is 3.88. This is well beyond the 1 per cent level. For the verbal scores, however, the value of "t" for the difference in final test scores is 1.43. This value of "t" falls between the 10 and 20 per cent level of significance.

In summary, it can be said that the experimental and control groups of both the employed and student subjects were evenly matched on initial scores. In the final test results, all of the differences were found to be significant well beyond the 1 per cent level with the exception of the comparisons in verbal response scores for the student group. For the latter the trend of change was the same as that of the employed group although the difference was not distinctly significant. Since studies of the Luria test tend to show that disturbances in voluntary responses are the more significant as indicators of conflict, and since significant changes in these scores appeared in both groups, we may conclude that the learning program produced significant changes in the experimental groups.

Comparison of Attitude Ratings

As indicated above ratings relative to five attitudes were obtained for the data gathered in the initial interview and on the self-report blank. The initial ratings were compared with final ratings obtained in a similar way at the close of the experiment.

In analyzing attitudes, since the subjects were not paired on attitude scores, the "t" test was applied to the initial and final scores of the control and experimental groups.

TABLE 2

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL TESTS BETWEEN EXPERIMENTAL AND CONTROL GROUPS (STUDENT GROUP)

Measures	N	Means of Differences	Σd^2	"t"	"t" for 1% Level of Significance
			Initial Test		
Voluntary disturbances	28	.85	1953	.12	2.771
Verbal scores	28	.25	1949	.20	2.771
			Final Test		
Voluntary disturbances	28	13.82	9655	3.88	2.771
Verbal scores	28	4.50	3968	1.43	2.771

The data for the employed group show that in no case did the control group gain (Table 3). In attitude toward parents, the value of "t" is zero, and for the other four attitudes studied a slight loss from initial to final scores appears though these differences are not significant.

In the employed experimental group, however, gains significant below the 1 per cent level are found in two attitudes,- attitude toward the place of sex in life and attitude toward self-determined goals and standards (Table 4). The attitude toward social problems shows a difference significant well below the 5 per cent level. The differences in the attitude toward parents and social status with the opposite sex are not significant.

In the student group, we find tendencies to lose on the part of the control group (Table 5) on four out of the five attitudes studied, and some gain in the attitude of social status with the opposite sex but none of the differences are significant.

In the student experimental group (Table 6), the data reveal differences significant below the 1 per cent level for three attitudes: attitude toward place of sex in life, toward self-determined goals and standards, and toward social problems. In the attitude of social status with the opposite sex, "t" was found to be significant below the 2 per cent level, while the difference in attitude toward parents is insignificant.

In conclusion, it can be said that in no case did the control group of either employed or student subjects make a significant gain in attitudes. On the other hand the experimental subjects in both cases showed significant changes. The student experimental group yielded differences well below the 1 per cent level in three attitudes, and a difference for the fourth significant below the 2 per cent level.

In the employed group two of the five attitudes measured showed differences significant below the 1 per cent level. A third, attitude toward social problems, yielded a difference significant well below the 5 per cent level. Differences in attitude toward social status with the opposite sex and attitude toward parents were not significant.

TABLE 3

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (EMPLOYED CONTROL GROUP)

Attitudes Measured	N	Means of Differences	d^2	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	25	.00	0	.00	2.797
2. Social status with opposite sex	25	.12	11	-.92	2.797
3. Toward place of sex in life	25	.08	4	-.97	2.797
4. Toward self-determined goals and standards	25	.24	6	-2.40	2.797
5. Toward social problems	25	.16	6	-1.60	2.797

TABLE 4

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (EMPLOYED EXPERIMENTAL GROUP)

Attitudes Measured	N	Means of Differences	d^2	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	25	.20	19	1.17	2.797
2. Social status with opposite sex	25	.40	28	1.61	2.797
3. Toward place of sex in life	25	.48	16	3.00	2.797
4. Toward self-determined goals and standards	25	.40	10	3.33	2.797
5. Toward social problems	25	.24	8	2.18	2.797

TABLE 5

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (STUDENT CONTROL GROUP)

Attitudes Measured	N	Means of Differences	$\leq d^2$	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	28	.14	6	-.15	2.771
2. Social status with opposite sex	28	.18	13	1.38	2.771
3. Toward place of sex in life	28	.035	9	-.35	2.771
4. Toward self-determined goals and standards	28	.43	30	-2.26	2.771
5. Toward social problems	28	.39	43	-1.69	2.771

TABLE 6

MEANS AND SIGNIFICANCE OF DIFFERENCES IN INITIAL AND FINAL RATINGS OF ATTITUDES (STUDENT EXPERIMENTAL GROUP)

Attitudes Measured	N	Means of Differences	$\leq d^2$	"t"	Value of "t" for 1% Level of Significance
1. Toward parents	28	.14	16	.94	2.771
2. Social status with opposite sex	28	.28	26	2.54	2.771
3. Toward place of sex in life	28	.67	35	3.14	2.771
4. Toward self-determined goals and standards	28	.50	16	3.57	2.771
5. Toward social problems	28	.57	26	3.16	2.771

The quantitative results may be summarized by saying that significant changes were produced in the experimental groups while no changes appeared in the control groups. It appears that a learning program of the type used in this study can bring about a significant change in the indications of conflict as revealed by the Luria test. It also appears that the learning program can produce significant changes in attitudes.

To obtain an indication of the way in which the learning program may bring about changes in the adjustments of young people several case studies were made. One representative case study will be reproduced here for the reader. Others will be found in Morgan (2).

Employed Experimental Subject #8

Number 8's problem was centered around his father's failure in business and the father's taking to drink. Being engaged and eager to be married, No. 8 felt great frustration at having to support the family. The family received some aid from another son, but the greater burden of support fell on No. 8.

The verbal responses regarding family relationships attained in the administration of the Luria test were studied to see what they reveal regarding No. 8's problem. Some of the responses in the test tend to show his frustrations as well as his desires or goals:

Stimulus Word	Responses
sin	drinking
liquor	bad
school debt	not paid
job	wages
lasting satisfactions	job
security	happiness
ideas worth living for	home
desire	job
sign of success	marriage

In his initial interview, in speaking of managing money, No. 8 burst out with,

> "If Dad were working it would be different. I like to save money. I like to put it in the bank. But, here I am this week with less than a dollar in my pocket. I spent $1.50 for gas for my brother's car; have seen one movie; and the rest has gone to the family. It had to."

"I want a good job which is secure," was No. 8's reply to the experimenter's question about what he hoped to be doing at thirty-five years of age. He told of having taken Civil Service Examinations four months before hoping to become a meat inspector.

> "I want to be married and have a family as I am engaged now, and we have been dating steady for nearly four

years. Four or five years ago my father had a meat business of his own. It went bad and he sold it and the money is gone too! Next he wanted to go on the road selling meat equipment. The selling game is o.k. on a salary with commission but just a commission as Dad is getting doesn't work. He makes nothing and the family are on my brother and me."

His happiest and most unhappy experiences appeared revealing. His most unhappy experience was when his father started drinking when his business "went bad."

"He doesn't drink now, but it surely played havoc."
"A happy experience? When was I on top of the world? Let me see...When I got my bicycle...In those days my father had a lot of money."

Number 8 told the experimenter that he did not think everyone had a square deal:

"I attended college at —— for one year. Believe me, I worked for it, worked at a gas station nights. In addition I worked out my tuition by mowing college lawns and painted college walls. The experiences I ran into didn't seem quite fair. Fellows with money to throw away all around me and they didn't make use of their opportunities. It was awful. I stuck it out for a year, but quit. Too, I had to help support the family."

During the group discussion of family relationships, No. 8 contributed very little. Several subjects told of families they knew where the father's loss of job or failure in business had caused utter loss of confidence on the part of the parents. We talked at length of the depression doing things to people for which they, themselves, were not responsible. One could not tell, though, what No. 8 was thinking.

In spite of No. 8's seeming bitterness regarding money and lack of economic security, he was a charming man to know. From things he said, it was evident that his childhood and youth up to the time of his father's failure in business had been a fine experience.

Socially, he was one of the outstanding men of the employed group, being liked by everyone. His contributions to discussion were objective and helpful. For example, someone said it would not be at all wise for a man who was not a college man to marry a woman who had been privileged to attend college. It was quite evident from the amount of emotion displayed that the majority of the group felt inferior because of lack of higher education. No. 8 said, in his calm way,

"I don't believe you folks are thinking straight on that. It would depend on the two people. Of course, I know the culture pattern is otherwise, but if the man were

fairly mature and they understood and loved each other, it could be done."

...

Later after the group had calmed down, No. 8 said,

"I, myself, am going to marry a girl who finished college this spring and I have had only one year of college." (No. 8 brought his fiancee to the last meeting of the group so that they might meet her.)

Because he knew the experimenter was interested in the results of his civil service examinations, he reported every week:

"I haven't heard yet. But no news is good news. Keep your fingers crossed."

One night he did not report, but the experimenter did not inquire, fearing that he had not passed. When he came for his teaching conference two weeks later, he reported that he had not passed the examination.

"I'm not going to let it get me down, though. I am liking my present work better all the while and there is a chance to advance in it."

As we talked on, No 8 said,

"The thing that did the most for me in this group was seeing my father's failure in business and his starting to drink all as a part of a larger social and economic problem. Why, Mrs. M----, as I thought it through, I'm sure he began drinking because he couldn't stand to face the failure. Of course, it just made matters worse when we lost what little money we had left. Always before, though, I had blamed him alone and never once thought of the situation...

"Understanding how it might have happened took all of the bitterness away. The family is doing better all around, now. ...

"You must have thought I was a great one to 'blow off' to you the way I did the first night."

An experimenter commented:

"At times we need a person outside the family with whom to talk over things that trouble us. It helps to put problems into words, sometimes. You are making spendid progress now."

About two months later, when No. 8 came to take his final test he related to the experimenter the following:

"We have bought a car together. He uses it for his work during the week and it is mine for weekends. It is just a used car. The finance corporation wouldn't let Dad have it unless I was a part of the deal. ...

"Gosh, but that must hurt a man who owned a good business once!

"At one time I would have rubbed it in, but now that I understand better I told him I was wanting a car, too. Neither of us could afford it alone, this was a real opportunity to go in together on it."

These data tend to indicate that as the subject gained insight and understanding of the possible causes of his father's behavior new ideas were available to him for working out a method of assisting the father and at the same time fulfilling his own desires.

Summary

In this study a learning program designed to develop an understanding of behavior in marriage, family and social relationships was administered to two experimental groups of young people. Each experimental group was paralleled by a matched control group. Measurements of conflict and selected attitudes were obtained before and following the administration of the learning program. A total of 106 subjects was used.

An analysis of the results indicated that the learning experiences were effective in the reduction of conflicts as measured by the Luria test and in producing significant changes in attitudes.

An analysis of individual records yielded qualitative data indicating in more detail the nature of the changes.

From both the quantitative and qualitative data it appears that signigicant changes can be made at the upper age levels through a learning program of the type used in this study. The significance of this finding is far-reaching. If the course of development of the relationships to others can be altered by methods now under our control, most significant consequences follow for the guidance of adolescents and youth.

In exploring this problem the limitations of our knowledge as to how to produce changes at the upper age levels must not be overlooked. We have some data to show that changes can be made. But how the changes can be made most efficiently, whether more powerful methods can be devised and at what point in the individual's life cycle various methods can be most effectively applied — these are some of the problems that must be subjected to extended study if we are to have effective programs in this area. A study on the high school level using high school juniors and seniors as subjects has produced results similar to those of this study. How far down in the educational scale we can go is not known.

We must also know more about how learning programs produce the changes we have noted. In case study No. 8 reported as a sample it can be seen that as the subject gained insight into and understanding of the possible causes of his father's behavior new ideas were available to

No. 8 and from these he could work out a plan to assist the father and at the same time to fulfill his own wants. There may, of course, be other paths by which the learning program produces its effects. Detailed studies are needed to reveal the many possibilities.

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THE GROWTH OF BONE, MUSCLE AND OVERLYING TISSUES IN CHILDREN SIX TO TEN YEARS OF AGE AS REVEALED BY STUDIES OF ROENTGENOGRAMS OF THE LEG AREA

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A method has been described (1) for the evaluation of the relative amounts of the three principal tissues of the body from the study of an x-ray film of the leg. The three tissues differentiated by film shadow densities are cutaneous-subcutaneous, muscle and bone. The method is applicable to children from 3 months to 7 years of age. This evaluation aids in interpreting body measurements such as height and weight and throws light on the state of nutrition. It helps especially to distinguish between amounts or increments of weight due to accumulation of fat and those attributable to stockiness of bones or development of muscles. It has been found to be a valuable adjunct to clinical examination and other approaches to the study of children (1, 2, 3).

The method previously described involves taking an antero-posterior roentgenogram of the leg, including knee and ankle, with the tube set at three-foot distance and following certain simple but important precautions as to the positions of tube, parts and film, and as to exposure. The tibial shaft area of film is then bounded by prescribed lines, and the tissue shadows within these lines are outlined. Tibial length and certain breadth measurements are first taken and then areas of tissue shadows are cut out and weighed on a chemical balance.[2] The earlier publication, therefore, made available a method of measuring, as well as norms for certain linear dimensions and certain areas of tissue shadows for young children. These procedures were found to give reliable results and to reveal characteristics of build for age and sex, as well as individual differences in these respects.

In the study of children over 6 or 7 years of age, it was found advisable to make certain changes in the technique to be followed, due to the increased length of the leg and to changes taking place at the lines of union of shaft and epiphyses. A new technique was, therefore, developed differing principally in the use of a six-foot tube distance and in the adoption of somewhat different criteria for the demarcation of the tibial shaft area. New norms have been developed, using these modifications of the earlier technique in studying children from 6 to 10 years of age inclusive. The establishment of norms by both techniques for children of 6 and 7 years allows for overlapping by the two methods in following individual children. Table 1 gives the figures obtained by

[1]*From the Department of Child Hygiene, Harvard School of Public Health and the Department of Pediatrics, Harvard Medical School. From studies made possible by a grant from the General Education Board of the Rockefeller Foundation.* *This is a second report describing a technique developed for the study of the growth of these tissues and giving norms based upon studies of a series of children. The former report (1) dealt with children up to 7 years of age.*

[2]*The following summary gives the technique recommended for the study of young children, but the reader who intends to apply this technique is urged to study the more detailed description given in the previous report (1).*

TABLE 1

COMPARISON OF THE MEDIANS OF THE FIRST TECHNIQUE AND THE SECOND TECHNIQUE AT SIX AND SEVEN YEARS OF AGE

Measurement	BOYS				GIRLS			
	Six Years		Seven Years		Six Years		Seven Years	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Length of Tibial Shaft	22.1	21.3	23.6	23.1	22.3	21.9	24.0	23.0
Breadth of Calf	8.0	7.9	8.0	8.1	8.2	8.2	8.6	8.5
Breadth of Muscle	6.9	6.6	7.1	6.9	6.8	6.9	7.2	7.1
Breadth of Tibia	1.7	1.7	1.8	1.8	1.7	1.7	1.8	1.8
Total Area*	146.8	133.0	157.6	150.8	152.9	143.1	174.5	161.5
Bone Area*	60.3	57.6	66.5	65.4	60.8	58.0	67.7	63.8
Muscle Area*	56.5	52.9	61.5	59.2	55.9	55.0	63.3	62.2
Skin + Subcutaneous Area*	24.5	23.2	25.2	24.3	31.1	30.0	33.2	33.4
Bone Area as percentage of Total	42.2	43.4	43.8	44.3	41.0	40.6	40.8	41.3
Muscle Area as percentage of Total	40.0	39.6	39.5	40.6	38.3	38.6	38.7	38.6
Skin + Subcutaneous Area as percentage of Total	17.2	17.2	16.8	16.6	21.2	20.8	20.5	20.4

*Values for these measurements of Areas by the First Technique are weights of film shadows multiplied by the conversion factor, 31.06.

both methods at these ages and shows that the measurements obtained by the young child or first technique are uniformly slightly larger than those obtained by the older child or second technique, due to elimination of distortion in the latter instance. The measurements themselves, therefore, should be related to the appropriate norms rather than compared directly. The table, however, shows that the percentages of total area represented by each tissue area are very similar for the two methods.

The measurements of tissue shadow areas used in developing these new norms for the older children have been obtained by use of a planimeter, in part because it has been found to save time, but principally to preserve the x-ray films for other purposes.

It is the purpose of this report to describe the technique to be adopted in the study of children 6 to 10 years of age and to present norms suitable for use in evaluating the various dimensions and tissue shadow areas at these ages. The norms previously published are still recommended for use with children from birth to 6 years.[3]

Footnote 2 continued from Page 195

The child lies flat on his back on the x-ray table, with both ischiae resting evenly without internal or external rotation, with the right leg fully extended at the knee, with the calf relaxed and resting gently on the table, and with the foot held perpendicular to the table. Since complete extension at the knee joint and near parallelism between leg and film are essential to accuracy, it is customary to have the assistant exert moderate pressure over the lower thigh with the left hand, while supporting the foot with the right.

The x-ray tube is centered over the broadest part of the calf and at three-foot distance from the film cassette. The latter must be long enough and so placed as to include the full length of the tibia and breadth of the calf on the film. The exposure must be such as to allow clear visualization of the outlines of skin, muscle and bone throughout the length of the tibial shaft. Using 100 milliampere current and 1/20 second exposure through 4½ years and 1/10 second exposure from 5 to 7 years, the voltage is varied in accordance with the thickness of the extremity.

Measurements are obtained from these films in the following manner: The mid-points on lines crossing the heads of the diaphyses of the tibia are marked, and a line is drawn through these two mid-points. Where this line leaves the diaphyses of the tibia at either end, transverse lines are drawn perpendicular to the original line. Some of the shafts of tibia and fibula are visible beyond these demarking lines and some of the epiphyses are included between them, but only the area included is studied.

The distance on the original longitudinal line bounded by the two transverse lines is measured and referred to as Tibial Length or Length of Tibial Shaft. This length is multiplied by a constant 0.3 and the product is laid off on the longitudinal line, measuring from the upper or proximal transverse line. A third transverse line, parallel to the others is drawn across the calf at this point and represents the greatest width of calf. This has been found to correspond to the greatest breadth at all ages under study, because the latter is not represented by a point on the external contours of the calf but rather by a zone.

Breadth of Calf, which is the breadth of the total area, Breadth of Muscle, which includes the bones and is Breadth of Calf less the two layers of skin and subcutaneous tissue, and Breadth of Tibial Shaft are measured directly on the middle transverse line. Breadth of Skin + Subcutaneous Tissue is derived by subtracting Breadth of Muscle from Breadth of Calf.

Following the determination of linear measurements, the tissue shadows are outlined. The total area is first cut away from the rest of the film, and the film representing this area is weighed. The skin + subcutaneous tissue shadow is then cut away from the muscle and the combined bone and muscle area of film is weighed. Finally the film shadows of the two bones are cut out and weighed together. Weights are taken on a chemical balance to ten milligram values. Weight of Total Area, Weight of Combined Bone and Muscle, and Weight of Bone are thus available directly. Weight of Skin + Subcutaneous Tissue is derived by subtracting Weight of Combined Bone and Muscle from Weight of Total Area, and Weight of Muscle is derived by subtracting Weight of Bone from Weight of Combined Bone and Muscle.

It must be emphasized that the measurements here described are of projection images, cast on films under standard conditions, and the values must not be thought of as actual values for anatomical sections of these parts.

[3]The norms previously published give values for areas of tissue shadows in terms of the weights of the film segments representing them. As comparison of these values with those for actual areas necessitates multiplication by the factor 31.06 and may cause confusion for those using both sets of norms, the values for the earlier ages are given as areas in Table 12 at the end of this article. The figure given on page 13, line 2 of the previous report for this conversion factor is in error and should be changed to read 31.06.

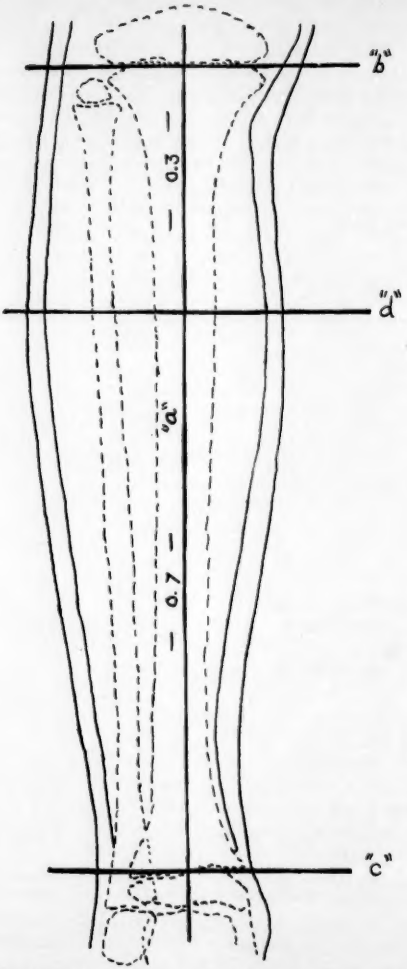

Figure 1. Tracing of Roetgenogram Showing Lines Used for Measurements. Antero-posterior view of right leg of a boy, age 7 years: "a" = vertical line bisecting heads of diaphyses; "b" = upper transverse line, perpendicular to "a" at upper end of tibial shaft; "c" = lower transverse line, perpendicular to "a" at lower end of tibial shaft; "d" = transverse line, parallel to "b" and "c" three-tenths length of tibial shaft below "b", representing greatest breadth of calf.

Modifications of Technique Adopted for Study of Older Children

The film is exposed under identical conditions of tube centering, leg position and position of cassette as described in Footnote 2 for the young child technique, but the distance between the focal point of the tube and the cassette is now extended to 6 feet. This in practice usually requires having the child lie on the floor, rather than on the x-ray table. It also involves certain changes in exposure. We have used a 65 milliampere current and a 0.25 second exposure, and have varied the voltage according to the size of the calf, the range being between 40 and 45 peak kilovolts. The principal advantage in the six-foot distance is that the distortion of shadows at these ages is considerably reduced, and it renders the image measurements much more like those of the anatomical parts.

The second point of difference in the older child technique has to do with locating the end points of the tibial shaft, which at these ages are becoming confused by the early stages of union with epiphyses. A vertical line (a, Figure 1) is drawn between the mid-points of the heads of the diaphyses. A ruler edge is held so that it passes through the notches formed by the diaphyseal heads and the epiphyses, and lines (b, and c, Figure 1) are drawn at right angles to the vertical line at the points where the ruler intersects the latter. The distance between these two horizontal lines is measured and gives the Length of Tibial Shaft. This figure is multiplied by 0.3, and a third line (d, Figure 1), parallel to the two horizontals, is drawn at a point on the vertical line this distance below the upper horizontal. The width of the calf measured on this line (d) has been found to represent the greatest width quite as well with these older children as it did at the earlier ages.

The planimeter is then used over an illuminating box to trace the outlines of the tissues and thus determine their areas. We have achieved greater accuracy and ease of operation by measuring the areas above and below the mid-line separately and then totaling the results. Two determinations are made of each tissue area, and if there is a difference of more than six-tenths of a square centimeter in the results, the measurements are repeated.

If a person desiring to make an evaluation of the leg tissues of an older child is not equipped with a planimeter, he may cut out and weigh the several tissue shadows, as described in Footnote 2 and multiply these weights by the factor 31.06 to find the actual areas in square centimeter values.

Tables 2 to 10 inclusive give the tenth and ninetieth percentiles, as well as the medians for each year of age from 6 through 10 for each of five linear and four area measurements. Length of Tibial Shaft and all breadth measurements are taken directly, except that of Skin + Subcutaneous Tissue, which is derived by subtracting Breadth of Muscle from Breadth of Calf. Total Area, Area of Bone and Muscle and Bone Area are measured directly, and from these Muscle Area and Skin + Subcutaneous Area are derived. The three percentiles chosen for presentation have been found satisfactory for practical purposes in evaluating measurements obtained on children. Table 11 gives the figures for the per cent of the total area of the leg represented by each of the three tissues.

Accompanying each table is a figure of corresponding number designed to portray the trend of growth in each tissue during this age period, as well as any sex differences. In the main, the trends of growth at this time appear to plot as straight lines.

Length and Breadth of Tibial Shaft (Figures 2 and 4) show little difference between the sexes during these years. It appears that girls fail to keep up with boys in amount of muscles, as shown in Breadth of Muscle and Muscle Area (Figures 5 and 9), tending to be on the average somewhat ahead at 6 years and somewhat behind at 10 years.

The curves for Breadth of Skin + Subcutaneous Tissue and Skin + Subcutaneous Area (Figures 6 and 10) show marked and consistent sex differences at all ages and obviously represent a fundamental difference in build. The medians, as well as the tenth and ninetieth percentiles, all plot at a considerably higher level for girls than boys. In fact, the tenth percentile for girls is usually quite near to the fiftieth for boys, and the median for girls sometimes exceeds the ninetieth percentile for boys. This difference was also observed at earlier ages, as noted in the previous report, and is clearly demonstrated in Figure 11, portraying the percents of total area represented by each tissue. In this figure, the girls show consistently a smaller percentage of total area than boys, represented by both bone and muscle, and a larger percentage by skin and subcutaneous tissue.

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TABLE 2

LENGTH OF TIBIAL SHAFT

No.	BOYS Percentiles 10th	50th	90th	Age in Years	GIRLS Percentiles 10th	50th	90th	No.
59	19.68	21.25	22.91	6	20.12	21.87	23.70	58
73	20.95	23.05	24.67	7	21.52	22.98	25.45	63
64	22.44	24.61	26.36	8	22.80	24.50	27.15	52
45	23.58	26.17	28.15	9	24.21	25.82	28.58	37
25	24.70	27.41	29.17	10	25.10	27.43	29.80	24

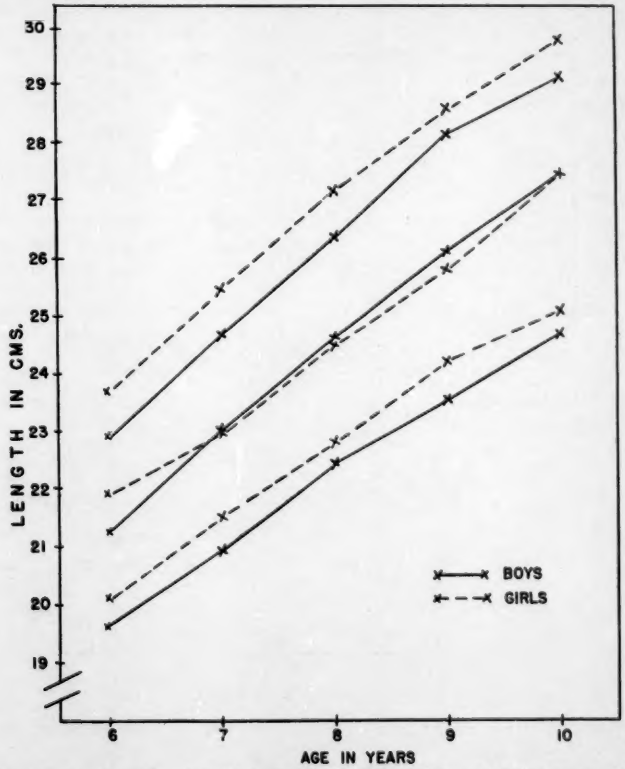

Figure 2. Length of Tibial Shaft. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 3

BREADTH OF CALF

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	7.04	7.87	8.71	6	7.24	8.20	8.72	58
73	7.21	8.09	9.22	7	7.52	8.46	9.04	63
64	7.62	8.43	9.46	8	7.73	8.60	9.54	52
45	7.82	8.66	9.88	9	8.02	8.70	10.06	37
25	7.83	8.79	10.17	10	7.80	8.75	10.80	24

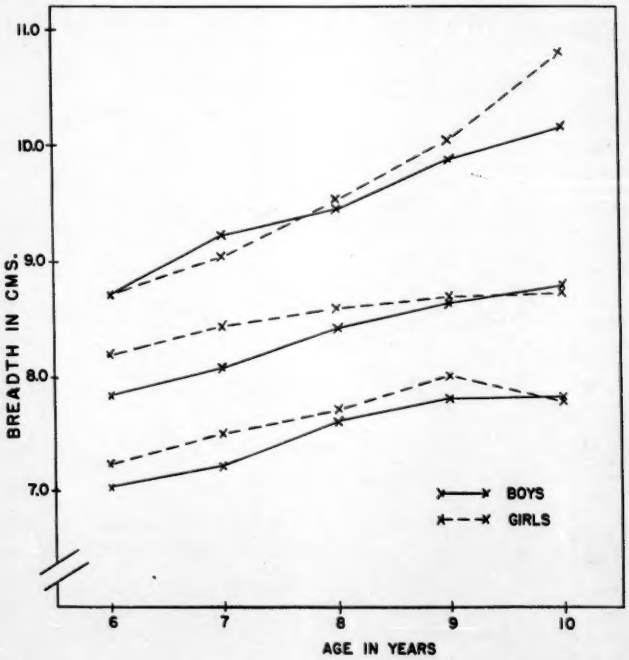

Figure 3. Breadth of Calf. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 4

BREADTH OF TIBIAL SHAFT
(AT GREATEST BREADTH OF CALF)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	1.62	1.72	1.99	6	1.60	1.75	1.94	58
73	1.77	1.84	2.04	7	1.66	1.84	1.99	63
64	1.76	1.94	2.13	8	1.71	1.90	2.07	52
45	1.85	2.01	2.29	9	1.77	1.97	2.15	37
25	1.91	2.15	2.35	10	1.83	2.04	2.23	24

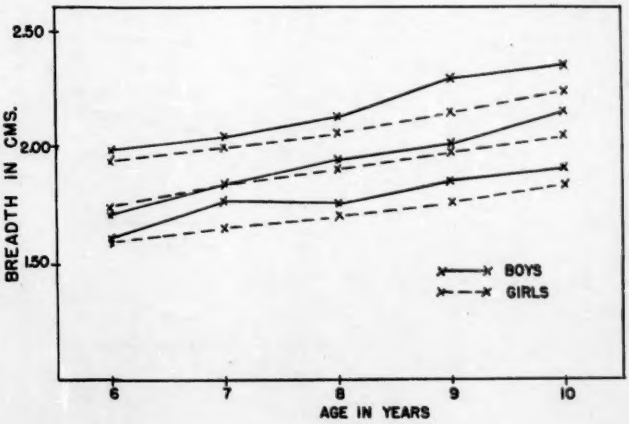

Figure 4. Breadth of Tibial Shaft. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 5

BREADTH OF MUSCLE
(TOTAL WIDTH, INCLUDING BONE SHADOWS AT GREATEST BREADTH OF CALF)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	6.06	6.60	7.68	6	6.09	6.94	7.48	58
73	6.35	6.92	8.02	7	6.42	7.13	7.91	63
64	6.60	7.26	8.20	8	6.49	7.25	8.28	52
45	6.88	7.64	8.67	9	6.64	7.38	8.46	37
25	7.10	7.72	8.85	10	6.69	7.50	8.72	24

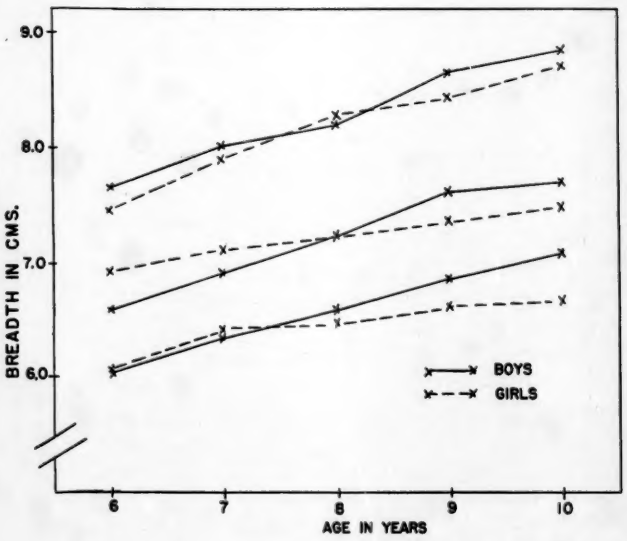

Figure 5. Breadth of Muscle. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 6

BREADTH OF SKIN + SUBCUTANEOUS TISSUE

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	0.78	1.06	1.34	6	1.02	1.35	1.71	58
73	0.76	1.04	1.39	7	1.00	1.32	1.69	63
64	0.82	1.06	1.45	8	1.12	1.35	1.79	52
45	0.81	1.06	1.45	9	1.12	1.33	1.93	37
25	0.82	1.11	1.46	10	1.12	1.38	1.86	24

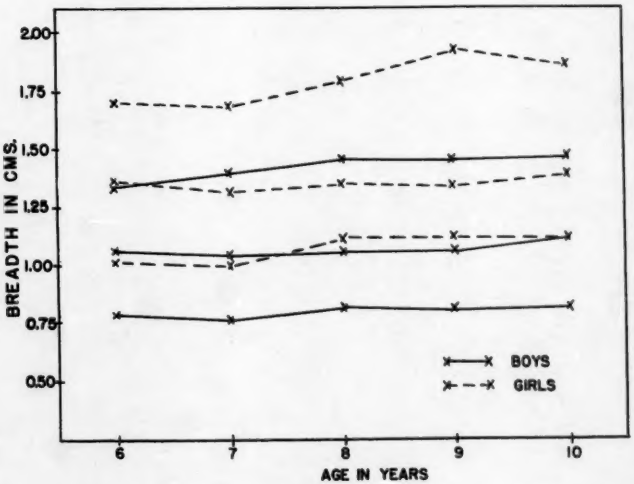

Figure 6. Breadth of Skin + Subcutaneous Tissue. 10th, 50th and 90th percentiles from six through 10 years.

TABLE 7

TOTAL AREA
(AREA OF SHADOW OF TOTAL SEGMENT)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	117.2	133.0	157.8	6	119.8	143.1	167.8	58
73	130.7	150.8	178.5	7	131.3	161.5	186.2	63
64	145.3	168.3	199.0	8	145.2	170.0	208.0	52
45	155.6	183.0	223.8	9	156.7	183.7	227.1	37
25	161.0	189.0	227.5	10	164.7	196.6	253.0	24

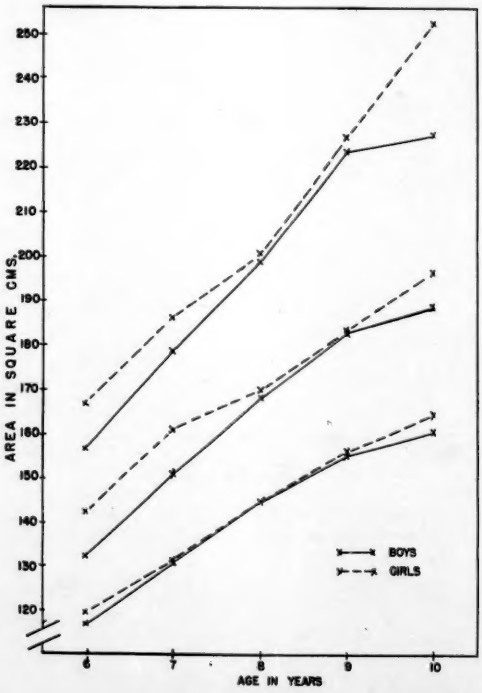

Figure 7. Total Area. 10, 50th and 90th percentiles from 6 through 10 years.

TABLE 8

BONE AREA
(AREA OF SHADOWS OF BOTH BONES)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	51.0	57.6	67.4	6	49.9	58.0	67.2	58
73	57.1	65.4	76.6	7	54.8	63.8	76.8	63
64	64.8	73.4	86.0	8	60.3	71.6	84.8	52
45	70.5	81.3	96.0	9	65.4	80.0	93.3	37
25	73.0	87.2	103.0	10	68.5	86.2	99.3	24

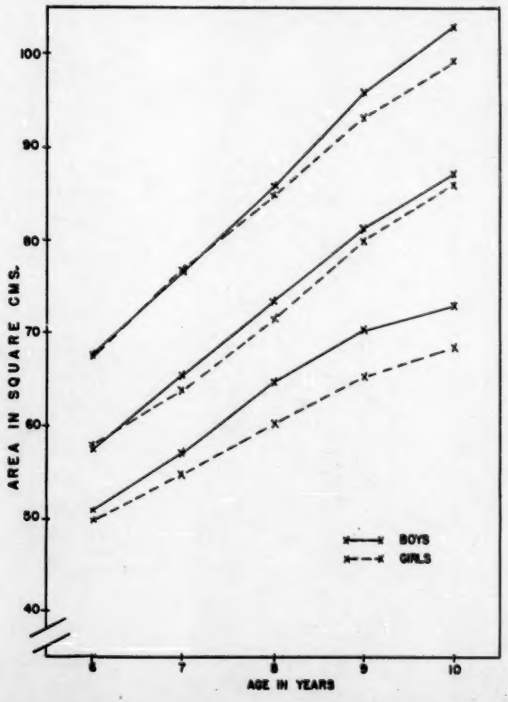

Figure 8. Bone Area. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 9

MUSCLE AREA
(AREA OF SHADOWS OF MUSCLES, NOT INCLUDING BONES)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	45.2	52.9	65.4	6	43.4	55.0	66.2	58
73	50.8	59.2	69.8	7	49.2	62.2	74.4	63
64	55.1	66.0	79.1	8	51.6	66.9	80.8	52
45	61.2	71.8	86.3	9	56.7	70.0	84.4	37
25	61.9	74.4	89.2	10	56.0	72.5	89.3	24

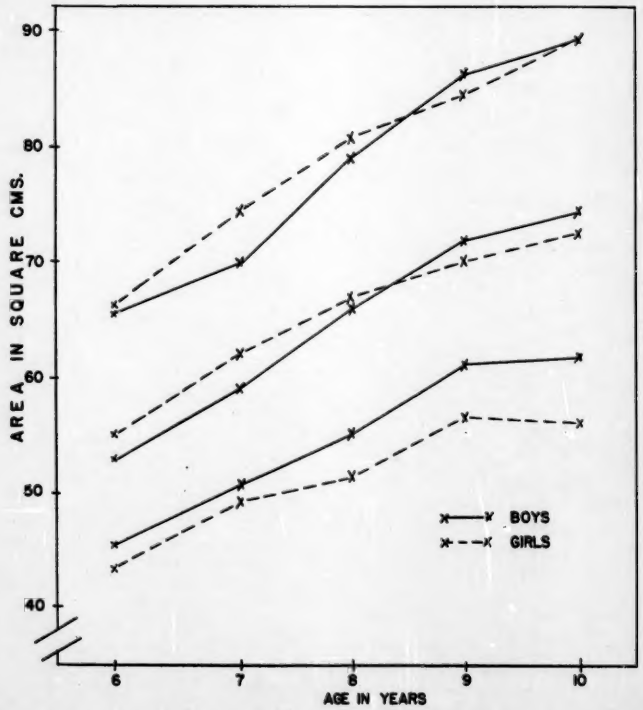

Figure 9. Muscle Area. 10th, 50th and 90th percentiles from 6 through 10 years.

TABLE 10

SKIN + SUBCUTANEOUS AREA
(AREA OF SHADOWS OF SOFT TISSUES OVERLYING MUSCLES)

BOYS					GIRLS			
No.	Percentiles			Age in Years	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
59	16.8	23.2	30.1	6	21.2	30.0	39.2	58
73	17.6	24.3	33.7	7	22.8	33.4	41.6	63
64	19.4	27.5	38.2	8	26.1	34.0	47.3	52
45	19.8	27.7	44.9	9	28.9	38.2	54.6	37
25	21.3	30.5	45.0	10	31.4	38.7	6. 9	24

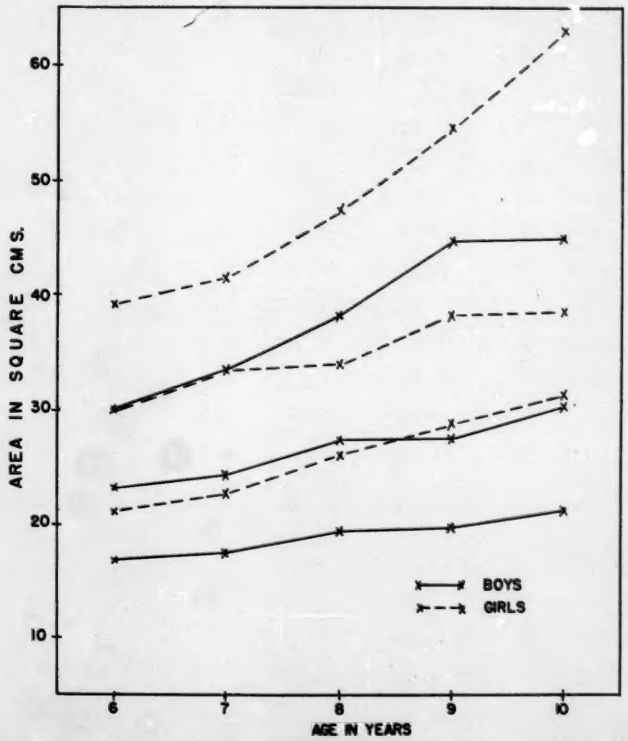

Figure 10. Skin + Subcutaneous Area. 10, 50th and 90 percentiles from 6 through 10 years.

TABLE 11

TISSUE AREAS AS PERCENTS OF TOTAL AREA

BOYS No.	BOYS Percentiles 10th	BOYS Percentiles 50th	BOYS Percentiles 90th	Age in Years	GIRLS Percentiles 10th	GIRLS Percentiles 50th	GIRLS Percentiles 90th	GIRLS No.
				BONE AREA				
59	41.3	43.4	47.2	6	37.6	40.6	44.4	58
73	40.2	44.3	48.0	7	37.7	41.3	45.2	63
64	40.1	44.4	48.1	8	37.8	41.6	45.7	52
45	40.9	45.1	48.7	9	38.6	41.8	46.3	37
25	40.7	45.5	48.8	10	37.4	42.3	47.0	24
				MUSCLE AREA				
59	36.2	39.6	43.1	6	33.9	38.6	41.9	58
73	35.1	40.6	42.6	7	33.7	38.6	42.4	63
64	35.3	39.2	43.3	8	34.0	37.9	41.9	52
45	34.6	38.2	43.3	9	34.3	37.5	41.6	37
25	34.8	38.4	43.5	10	31.0	36.6	42.0	24
				SKIN + SUBCUTANEOUS AREA				
59	13.6	17.2	21.3	6	16.6	20.8	24.7	58
73	12.7	16.6	20.9	7	16.2	20.4	24.9	63
64	12.4	16.6	20.9	8	16.5	20.5	24.7	52
45	11.9	16.1	21.1	9	16.5	19.9	26.3	37
25	12.2	16.2	20.5	10	16.2	20.8	24.8	24

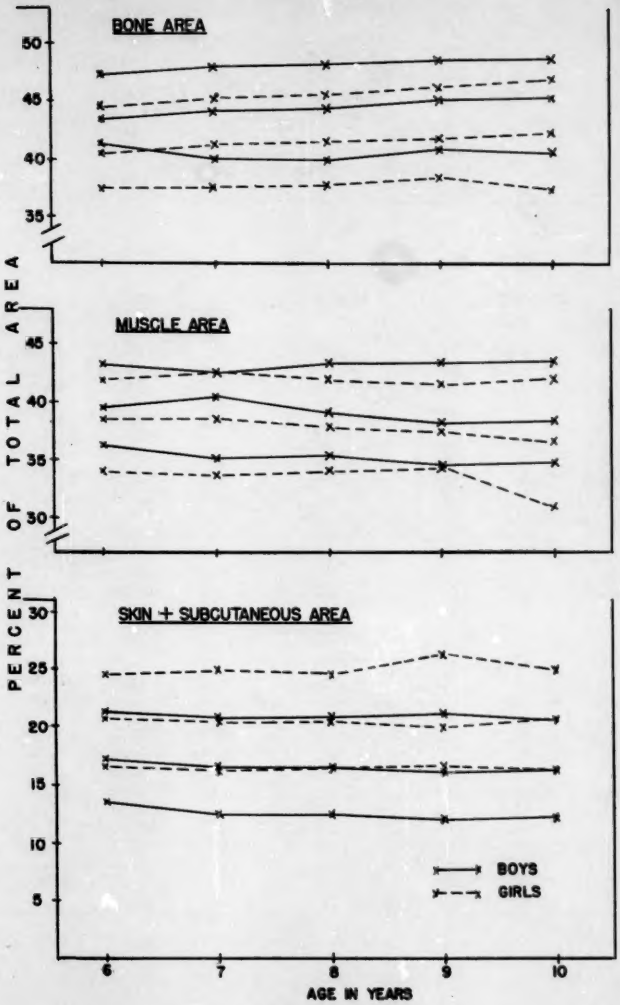

Figure 11. Tissue Areas as Percentages of Total Area: Bone Area; Muscle Area; Skin + Subcutaneous Area. 10th, 50th, and 90th percentiles from 6 through 10 years.

TABLE 12

AREAS FOR EARLIER AGES BY YOUNG CHILD TECHNIQUE, IN SQUARE CENTIMETERS

Calculated from weights of film segments, as described in Footnote 3, page 197

TOTAL AREA

BOYS					GIRLS			
No.	Percentiles			Age in Months	Percentiles			No.
	10th	50th	90th		10th	50th	90th	
66	32.0	38.8	44.7	3	32.0	38.2	43.8	68
63	43.1	51.9	57.8	6	42.6	50.0	56.5	64
57	51.9	60.2	66.5	9	49.7	58.6	66.5	59
77	58.1	67.4	74.9	12	56.6	65.6	74.2	74
58	66.5	77.0	86.3	18	65.2	75.6	88.0	60
74	73.6	85.6	96.0	24	75.8	85.4	101.1	79
66	82.3	92.2	103.0	30	77.6	92.5	111.8	62
79	88.2	100.9	115.8	36	89.4	101.8	119.8	79
60	95.3	106.3	121.0	42	96.0	111.1	129.2	55
72	99.9	114.9	132.1	48	102.8	119.1	143.2	75
52	105.8	124.8	142.8	54	108.0	126.7	149.0	60
72	111.8	130.0	147.0	60	115.3	132.2	153.5	67
54	116.4	138.0	159.1	66	120.1	140.6	163.3	54
53	126.3	141.5	164.1	72	125.8	147.3	169.1	45

BONE AREA

66	10.9	12.4	13.9	3	10.2	11.8	13.0	68
63	13.7	15.2	17.4	6	12.7	14.6	16.8	65
57	15.8	18.3	20.1	9	14.3	17.4	20.2	59
77	17.4	21.1	23.9	12	17.4	20.5	23.9	73
58	23.3	27.0	30.8	18	21.8	26.1	30.4	60
74	27.1	31.7	35.7	24	26.7	31.4	36.1	79
66	30.8	36.0	40.7	30	30.4	34.8	41.6	62
79	34.5	39.8	45.6	36	34.2	38.8	45.0	79
60	37.6	42.6	49.1	42	37.9	41.9	48.5	55
72	41.0	46.9	55.3	48	39.8	46.6	54.4	75
52	43.2	51.2	58.7	54	43.5	50.3	57.5	60
72	46.6	53.5	62.7	60	46.0	54.4	62.4	67
54	48.7	56.3	65.2	66	50.0	57.6	67.0	54
52	52.6	60.3	68.3	72	52.1	60.9	69.3	45

TABLE 12 (CONTINUED)

MUSCLE AREA

No.	BOYS Percentiles 10th	50th	90th	Age in Months	GIRLS Percentiles 10th	50th	90th	No.
66	11.5	13.7	14.9	3	10.9	12.4	14.9	68
63	13.7	16.8	18.6	6	13.7	15.5	18.3	64
58	16.1	19.6	22.1	9	15.2	18.9	22.3	59
77	19.6	23.0	27.0	12	18.3	21.7	26.4	74
58	22.6	27.1	30.5	18	21.4	25.5	29.5	60
74	24.9	29.5	35.4	24	23.9	28.3	33.6	79
66	28.3	33.2	39.5	30	26.1	32.3	38.9	62
79	31.1	36.3	42.8	36	30.7	35.7	43.5	79
59	33.2	40.1	46.9	42	33.6	40.1	49.1	55
73	37.3	44.1	50.6	48	36.4	44.4	52.5	75
52	40.4	46.6	55.6	54	39.8	48.2	56.6	60
72	42.6	48.7	58.4	60	42.6	50.4	60.3	67
54	45.6	54.4	65.8	66	43.8	54.1	63.0	54
53	49.1	56.5	66.5	72	46.3	55.9	64.6	45
				SKIN + SUBCUTANEOUS AREA				
66	9.9	12.7	17.4	3	10.9	14.0	16.8	68
63	14.6	19.6	23.6	6	15.8	19.9	23.6	64
57	16.5	22.4	27.6	9	17.1	22.7	27.6	59
77	17.4	23.3	28.0	12	18.0	23.0	28.6	74
58	17.7	24.2	28.0	18	19.3	24.2	29.5	60
74	19.2	24.5	29.2	24	20.8	26.1	33.6	79
66	19.6	23.9	29.8	30	21.8	27.0	34.2	62
79	18.9	24.8	30.7	36	22.0	28.0	34.2	79
59	18.9	24.2	32.6	42	22.3	28.3	37.6	55
72	19.2	24.2	32.3	48	22.3	29.5	38.5	75
52	20.5	25.5	33.2	54	23.9	29.5	38.8	60
72	19.2	24.2	33.2	60	24.5	29.8	39.8	67
54	19.2	24.5	33.2	66	22.3	30.7	41.0	54
53	18.6	24.5	34.8	72	24.2	31.1	40.1	45

A STUDY OF THE McCLOY METHOD FOR DETERMINING NORMAL WEIGHT

MARY M. CLAYTON[1]

Ever since Emerson (1) began his nationwide attempt to improve the nutrition of American children by bringing them up to "normal" weight, physicians and other health workers have realized that there are fallacies in the method. One of the greatest of these is that the use of standard tables based on averages for age, height, and weight gives only a wide zone of normality and necessarily introduces errors into the determination of standard weights for children having skeletal builds which differ from the average.

Numerous attempts have been made to work out more accurate methods for determining normal weight which would make use of other skeletal measurements besides height. As early as 1886 Bornhardt (2) used chest circumference, together with height, in the prediction of the body weight of adults. In 1919, Dryer (3) used chest girth and stem length. Of these two methods Gray and Root (4) found the latter more accurate in predicting the normal weight of adults. In preparing his ideal weight tables for boys, Gray (5) used an average of weight for stem and weight for chest. Lucas and Pryor (6) advocated the use of bi-iliac diameter and height and in 1936 Pryor (7) published her width-weight tables. These have recently (8) been revised to make use of measurements of bi-iliac diameter, chest width (nipple level), and height.

The above workers did not attempt to correct their measurements for subcutaneous fat. As McCloy (9, p. 67) points out, the inclusion of fat would introduce errors which would increase in proportion to the thickness of the fat over the bones involved.

The McCloy Method

In his method for determining normal weight McCloy (9, 10) uses measurements of height, chest circumference at the xiphoid level (corrected for fat), bi-iliac hip width (corrected for fat), and knee width (not corrected for fat). By statistical methods he found these measurements to be closely correlated with weight. His reason for making the chest measurement at the xiphoid level, in preference to the level of the 4th costo-sternal articulation, is that it is an easy one to secure in both males and females and is below the scapulae and the largest muscle bulks of the chest. Also, in the majority of individuals, fat at this level is easily measured by the use of the subcutaneous tissue calipers devised for the purpose. The choice of hip width at the iliac crests in preference to the level at the greater trochanters was made in order to avoid the thick fat pads in the latter location. The supra-iliac fat is also measured with the fat calipers.

[1]*From Maine Agricultural Experiment Station, Orono.*

Use of Method in Present Study

The McCloy method for determining normal weight was recently (1936-40) used by the writer in a 4-year study of the nutritional status of grade-school children in Newport, Maine. In this study, measurements were made fall and spring on all of the children in the school (approximately 230). During the 4 years 1849 sets of measurements and calculations of normal weight were made. The method was also used in the fall of 1940 and 1941 on 263 college freshman girls. The results were used in the present study in order to show how the McCloy weight standards apply to Maine children whose skeletons are, in general, somewhat narrower than those of the Iowa children who were used in working out the standards; to show how they compare with the Baldwin-Wood and new Pryor (8) standards; and to give some evidence regarding the reliability of the McCloy weight indices as applied to children having widely differing types of bony skeletons and amounts of subcutaneous tissue.

In the determination of normal weight it was McCloy's intention to make use of measurements which, when corrected for fat, would be approximately those of persons weighing the correct amount for their age, sex, and skeletal builds. There is no way of testing the true accuracy of the fat corrections on living persons, but the validity of the determinations of normal weight has been studied by the writer in a number of ways.

Relationship Between McCloy Weight Indices and Nutrition Estimates

The first method used was to study the relationship between the McCloy weight indices ($\frac{\text{actual weight}}{\text{normal weight}} \times 100$) and estimates of nutrition[2] of the Newport children as made by the writer in the spring of 1940. This was done by determining Pearson's coefficient of contingency (Love, 11, p. 165). In determining this coefficient the weight indices were grouped as follows, according to the suggestions for judging underweight and overweight made by McCloy (10, p. 110):

115.01 and above	(overweight)
108.00 - 115.00	(slightly overweight)
96.01 - 107.99	(normal range)
96.00 - 94.00	(slightly underweight)
93.99 and below	(underweight)

Nutrition estimates were grouped as follows: overweight, slightly overweight, good, fair, poor.

For 108 boys the coefficient of contingency was .765; S.E. ± .040 and for 102 girls it was .610; S.E. ± .062. It thus appears that there was fairly good correlation between the McCloy weight indices and the estimates of nutrition. The failure to secure as good correlation in the girls as in the boys may be explained as probably due to the fact many of the girls tended to be somewhat underweight, but the examiner became so accustomed to seeing them that they were sometimes rated as

[2] *In making the nutrition estimates other factors than weight were considered, but weight was one of the most important. The condition of the teeth and gums was not included.*

"normal". On the other hand, those who were actually normal, or merely slightly overfat, were sometimes rated as "slightly overweight". She is of the opinion that, except in a small percentage of cases (to be discussed later), the McCloy weight indices are more accurate than her own judgment of weight. These probable errors in judgment, together with the fact that other factors than weight were included in the nutrition estimates, could explain the lack of perfect correlation.

McCloy Fat and Limb Girth Indices

The McCloy system of appraising physical status also includes methods for determining normal fat and normal limb girth. Therefore, both fat and limb girth indices may be determined. Used together with the weight index, these indices are of use in determining whether or not a child has a normal distribution of muscle and fat.

In the determination of the fat index[3] 4 fat measurements (chest front, chest back, abdomen, and supra-iliac)[4] are taken and the sum compared with averages for each age and sex.[5]

Limb girth indices $\left(\frac{\text{actual limb girth}}{\text{normal limb girth}} \times 100\right)$ are determined by use of measurements of the girths of chest, upper arm, fore arm, thigh, and calf and the widths of elbow and knee. Standards for each age and sex are based on these same measurements.

Relationship Between Fat and Limb Girth Indices and Nutrition Estimates

The relationships between the McCloy fat and limb girth indices and the estimates of nutrition were also studied by the determination of the coefficients of contingency. The results were as follows:

Fat indices and nutrition estimates - girls.
Coefficient .608; S.E. ± .063.
Fat indices and nutrition estimates - boys.
Coefficient .586; S.E. ± .064.
Limb girth indices and nutrition estimates - girls.
Coefficient .277; S.E. ± .092.
Limb girth indices and nutrition estimates - boys.
Coefficient .269; S.E. ± .090.

It will be noted that the coefficients for the fat indices and nutrition estimates were almost as high as those for the weight indices, but that those for the limb girth indices and nutrition estimates were very low.

[3] McCloy gives 2 formulas for determining the fat index:

1. $\frac{\text{Actual fat}}{\text{Normal fat}} \times 100$. With this index the normal range is 90 to 120 inclusive.
2. $\frac{\text{Actual fat minus normal fat}}{\text{Normal minus minimum}} \times 100$. With this index the normal range is 67 to 166 inclusive.

[4] In adolescent girls, or those past adolescence, the fat over the trochanters is measured by determining the "hip difference". (See McCloy, 9, p. 123).

[5] McCloy (10, p. 52) also gives equations for the prediction of total normal trunk fat from body build measurements, but for general purposes recommends the use of averages for each age and sex.

Comparison of McCloy and Baldwin-Wood Weight Standards

The second method used to study the validity of the determinations of normal weight was to compare the standard weights (according to both the McCloy and Baldwin-Wood standards) of pairs of children who were of the same sex and approximately the same height and age, but widely differing builds. An example of this type of comparison follows:

	Case 1	Case 2
Sex	F	F
Age	9.99	10.08
Height	52.3 in.	51.9 in.
Chest girth	54.8 cm.	62.4 cm.
Hip width	20.6 cm.	21.2 cm.
Knee width	7.5 cm.	8.3 cm.
Actual weight	49.8 lbs.	70.2 lbs.
Standard weight (McCloy)	57.5 lbs.	70.2 lbs.
Standard weight (Baldwin-Wood)	62.0 lbs.	62.0 lbs.
Per cent over or underweight according to McC.	-13.5	0.0
Per cent over or underweight according to B.-W.	-19.7	+13.2
Nutrition estimate	Poor	Good
Per cent over or under fat according to McC.	-42.0	- 1.4

It will be seen that these girls differed especially in chest circumference, yet by the Baldwin-Wood standards both should have weighed 62 pounds. This would have made Case 1 19.7 per cent underweight and Case 2 13.2 per cent overweight. Case 1 was definitely underweight but owing to her narrow skeleton she was not as much underweight as the Baldwin-Wood standard indicated. The McCloy standard, which was 4.5 pounds less than the Baldwin-Wood, therefore seems more correct for this girl. Case 2 appeared to weigh the right amount, so the McCloy standard again seems to be more correct.

Height and Weight Curves with Study of Weight Standards

The third method of study was to plot the height and weight curves of a number of children for the 4-year period during which they were weighed 8 times. Curves showing the McCloy and Baldwin-Wood standards were also plotted on each child's weight chart. These curves were of considerable value in studying the applicability of each standard to each individual case. Figure 1 gives the height and weight curves for Case 2, whose measurements at the time of her first examination are given above. The following facts can be noted by a study of this figure:

1. For this girl, whose skeleton was larger than the average, the McCloy standards apply much better than the Baldwin-Wood.

2. With rapid gains in weight, such as occurred between ages 11.1 and 11.7 and again between 12.1 and 12.7, the standards increase somewhat more than would be expected for the gains in weight. At ages 11.7 12.1 and 12.7 this girl is very slightly underweight by the McCloy standards, although she appeared to be overweight.

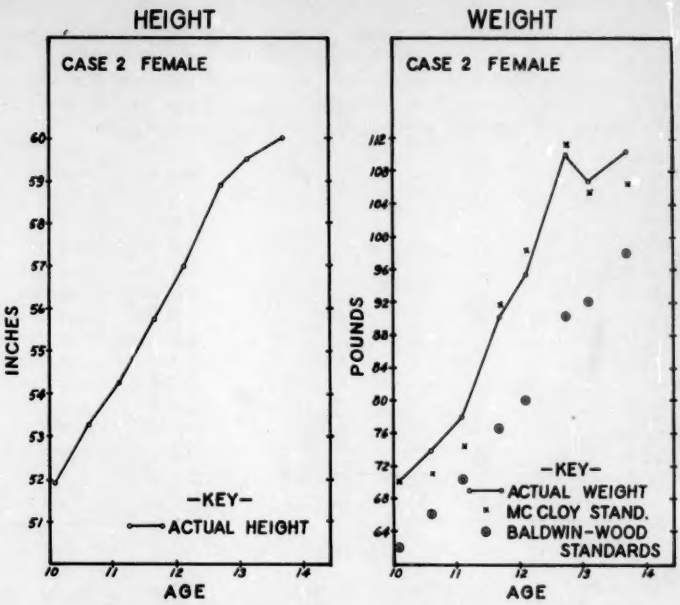

Figure 1. Height and weight curves for Case 2 showing McCloy and Baldwin-Wood weight standards.

3. With a weight loss of 3 pounds, such as occurred between ages 12.1 and 12.7 there is a corresponding decrease in the standard of 5.9 pounds.

McCloy Weight Standards for Subjects Gaining Weight or Overweight

Since the study of the McCloy weight standards for Case 2 (Figure 1) seems to indicate that with a rapid increase in weight there is a tendency for the standards to increase more than would be expected, a study was made of the weight and fat indices of 43 grade-school children and 68 college girls who were judged by the writer to be "slightly overweight" or "overweight".[6] Table 1 gives the distribution of subjects according to their weight indices $\left(\frac{\text{actual weight}}{\text{normal weight}} \times 100\right)$. It will be seen that among the "slightly overweight" subjects 100.0 per cent of the grade-school girls, 44.4 per cent of the grade-school boys, and 73.8 per cent of the college girls had weight indices which McCloy considers within the normal range (98.00-107.99). Among the "overweight" subjects 73.3 per cent of the girls, 40.0 per cent of the boys, and 42.3 per cent of the college girls also had weight indices within the normal range.

[6]The entire group examined included 564 girls, 555 boys, and 263 college girls.

TABLE 1

DISTRIBUTION OF McCLOY WEIGHT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS JUDGED AS "SLIGHTLY OVERWEIGHT" OR "OVERWEIGHT"

Weight Index	Nutrition Estimates					
	Slightly Overweight			Overweight		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
122.00-123.99			1			
120.00-121.99						
118.00-119.99					1	1
116.00-117.99						1
114.00-115.99			1			2
112.00-113.99			1	1	2	5
110.00-111.99		3	6	2	1	2
108.00-109.99		2(55.6%)	1(23.8%)	1(26.7%)	2(60.0%)	4(57.7%)
106.00-107.99		2	5	2	1	3
104.00-105.99	2	2	6	1	1	1
102.00-103.99	2		7			5
100.00-101.99	2		6	2	1	1
98.00- 99.99	1		7	4	1	
96.00- 97.99	2(100.0%)	(44.4%)	(73.8%)	2(73.3%)	(40.0%)	1(42.3%)
94.00- 95.99			1(2.4%)			
Totals	9	9	42	15	10	26
% of total no. examined	1.6	1.6	16.0	2.7	1.8	9.9

TABLE 2

DISTRIBUTION OF McCLOY FAT INDICES OF GRADE-SCHOOL CHILDRFN AND COLLEGE FRESHMAN GIRLS JUDGED AS "SLIGHTLY OVERWEIGHT" OR "OVERWEIGHT"

Fat Index	Nutrition Estimates					
	Slightly Overweight			Overweight		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
200.00-204.99					1	
195.00-199.99						
190.00-194.99						
185.00-189.99					1	
180.00-184.99				1	1	
175.00-179.99				1		1
170.00-174.99						
165.00-169.99		1	1		2	
160.00-164.99			2			2
155.00-159.99				2		1
150.00-154.99		1	1	1	2	2
145.00-149.99		2	2	1		3
140.00-144.99		1	3	1		2
135.00-139.99	2	2			1	3
130.00-134.99			4			7
125.00-129.99		2	5			3
120.00-124.99			4			1
115.00-119.99	1		4	1		
110.00-114.99	1(44.4%)	(9.0%)	9(83.3%)	1(60.0%)	1(90.0%)	1(100.0%)
105.00-109.99	2		4	2	1	
100.00-104.99	1		1	1		
95.00- 99.99	(33.3%)		1(14.3%)	2(33.3%)	(10.0%)	
90.00- 94.99			1	1		
85.00- 89.99	2(22.2%)		(2.4%)	(6.7%)		
Totals	9	9	42	15	10	26

Table 2 gives the distribution of the same subjects according to their fat indices ($\frac{\text{actual fat}}{\text{normal fat}} \times 100$). Of the "slightly overweight" grade-school girls, 33.3 per cent had fat indices between 95.00 and 109.99 (a range chosen by the writer to correspond more closely with the normal weight range than the 90-120 used by McCloy). None of the "slightly overweight" boys and only 14.3 per cent of the "slightly overweight" college girls had indices within this range. Among the "overweight" subjects 33.3 per cent of the girls, 10.0 per cent of the boys, and none of the college girls had fat indices within the chosen normal range.

To summarize the data given in Tables 1 and 2: while 63.1 per cent of the "slightly overweight" and "overweight" subjects had weight indices within the normal range (96.00-107.99), only 13.5 per cent had fat indices within the chosen normal range (95.00-109.00). Therefore, even allowing for some probable errors in the judgment of overweight (as in the case of the grade-school girls) and for the possibility that some of the subjects who appeared to be overweight were merely overfat and poor in muscular development, it appears that the McCloy weight standards for overweight subjects are somewhat high, thus giving low weight indices.

Position of Weight Standards for Fat Children on Wetzel Grid Charts

In connection with the above discussion of weight standards for fat children it may be stated that the McCloy normal weights[7] (and actual heights) for the subjects judged as "slightly overweight" or "overweight" were plotted on the Wetzel (12) grid charts.[8] For 28 of the subjects the points fell in channel A_4, which is used by Wetzel to classify children as obese. Although some of the 28 had large frames, it does not seem possible that all of them had skeletons large enough to place them normally in channel A_4, instead of A_3 or A_2 which Wetzel uses to classify children as stocky.

McCloy Weight Standards for Subjects Losing Weight or Underweight

A study of the McCloy weight standards for Case 2 (Figure 1) also shows that with a weight loss there is a decrease in the weight standard. Since a child's skeleton would not decrease in size, no matter what the weight loss, it appears that this decrease must be due to an inadequacy in the method of determining the standard.

In order to determine the frequency with which a decrease in the weight standard occurred when there was a weight loss, a study was made of all of the changes in the standard which accompanied weight losses during a 6-month period. During the 4-year study of the Newport children there were 28 instances of weight loss, 9 of which were accompanied by a decrease in the McCloy weight standard. It should be stated, how-

[7] *Instead of the actual weights.*

[8] *These charts have been published for use in following a child's progress in growth and for determining his body build, developmental level, and basal metabolism. Information to be secured from the grid is all obtained from measurements of height and weight alone. Wetzel apparently proposes that the physician's judgment be relied on to determine whether or not the child is developing along the correct channel, as indicated on the grid chart.*

ever, that in most cases this decrease was very slight (average 1.3 lbs.).

Since the McCloy weight standards show this tendency to decrease when there is a weight loss, a study was made of the weight and fat indices of the 237 grade-school children and 65 college girls who were judged by the writer to have fair or poor nutrition. Table 3 gives the distribution of these subjects according to their weight indices. It will be seen that among the subjects judged "fair", 11.0 per cent of the grade-school girls, 33.0 per cent of the boys, and 30.2 per cent of the college girls had normal weight indices. Of the subjects judged "poor" 3.1 per cent of the grade-school girls and 37.5 per cent of the boys had normal indices. It should be stated, however, that some of the children were rated "fair" or "poor" on account of defects other than apparent underweight and thus were among those with normal weight indices.

TABLE 3

DISTRIBUTION OF McCLOY WEIGHT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS ESTIMATED AS HAVING FAIR AND POOR NUTRITION

Weight Index	Nutrition Estimates					
	Fair			Poor		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
108.00-109.99			1(1.6%)		1(12.5%)	
106.00-107.99						
104.00-105.99		1	1			
102.00-103.99		1	1		1	
100.00-101.99	2	7	3		1	
98.00- 99.99	2	10	6			
96.00- 97.99	6(11.0%)	16(33.0%)	8(30.2%)	1(3.1%)	1(37.5%)	
94.00- 95.99	10	18	7	2	1	
92.00- 93.99	18	26	21	1	1	
90.00- 91.99	17	16	8	3	2	
88.00- 89.99	9	8	5	7		1
86.00- 87.99	19	3	1	5		
84.00- 85.99	4			3		1
82.00- 83.99	2		1	3		
80.00- 81.99	1			2		
78.00- 79.99	1			1		
76.00- 77.99				3		
74.00- 75.99	(89.0%)	(67.0%)	(68.2%)	1(96.9%)	(50.0%)	(100.0%)
Totals	91	106	63	32	8	2
% of total no. examined	16.1	19.1	24.0	5.7	1.4	.8

Table 4 gives the distribution of subjects according to their fat indices. Of those rated "fair", 5.5 per cent of the girls, 7.5 per cent of the boys, and 12.7 per cent of the college girls had fat indices within the normal range chosen by the writer (95.00-109.99).

To summarize the data given in Tables 3 and 4: while 22.5 per cent of the subjects judged "fair" or "poor" had normal weight indices, only 7 per cent had fat indices within the chosen normal range. It therefore appears that the McCloy weight standards for underweight subjects are somewhat low, giving high weight indices.

TABLE 4

DISTRIBUTION OF McCLOY FAT INDICES OF GRADE-SCHOOL CHILDREN AND COLLEGE FRESHMAN GIRLS ESTIMATED AS HAVING FAIR AND POOR NUTRITION

Fat Index	Nutrition Estimates					
	Fair			Poor		
	Girls	Boys	Col. Girls	Girls	Boys	Col. Girls
145.00-149.99			1			
140.00-144.99						
135.00-139.99						
130.00-134.99						
125.00-129.99						
120.00-124.99						
115.00-119.99						
110.00-114.99			1(3.2%)			
105.00-109.99		1	2			
100.00-104.99	1	2	1			
95.00- 99.99	4(5.5%)	5(7.5%)	5(12.7%)			
90.00- 94.99	2	20	11		1	
85.00- 89.99	7	22	11		2	
80.00- 84.99	18	25	10	3	3	
75.00- 79.99	28	26	13	5	1	1
70.00- 74.99	22	5	4	5	1	1
65.00- 69.99	9		3	11		
60.00- 64.99			1	6		
55.00- 59.99	(94.5%)	(92.5%)	(84.1%)	2(100.0%)	(100.0%)	(100.0%)
Totals	91	106	63	32	8	2

Possible Explanations for Increases and Decreases in Weight Standards

The above mentioned increases in weight standards which may accompany increases in fat, and decreases which may accompany decreases in fat, can be partly explained as due to the fact that the McCloy method does not always allow for accurate correction of the chest circumference measurements for fat. In individuals gaining in fat there is an increase not only in the subcutaneous fat which can be measured with the fat calipers, but also in the fat of the deeper muscle tissues, which cannot be measured. The chest circumference measurement is corrected only for subcutaneous fat and the use of too high a chest circumference gives too high a standard weight. A slight error is also introduced by using a knee width which is uncorrected for fat.

The opposite situation exists in the case of a child who is losing weight. Fat is lost[9] in both superficial and deep tissues, but correction is made only for the subcutaneous fat which can be measured with the fat calipers. This gives too low a chest circumference and too low a weight standard.

As suggested by Dr. McCloy, another factor which may cause errors in fat measurements is the fact that when a thick layer of fat is being measured there is high tension on the spring in the subcutaneous tissue calipers. This tends to give too low a fat measurement, which results

[9] *In extreme cases of weight loss muscle may also decrease. This would also influence the chest circumference measurement to some extent.*

in too high a corrected chest circumference and too high a weight standard. In the measurement of a very thin layer of fat the opposite situation may exist. Less tension on the spring tends to give too high a fat measurement, which results in too low a corrected chest circumference and too low a weight standard.

Comparison of McCloy and Pryor Weight Standards

The above mentioned inaccuracies of the McCloy weight standards for markedly overfat and emaciated individuals made it seem desirable to compare the McCloy and Pryor standards on a group of identical subjects. The necessary measurements had been taken by the writer on the previously mentioned group of 263 college freshman girls. Table 5 gives the results of this comparison. It will be noted that in the majority of cases the McCloy standards were lower than the Pryor. Also, it was found that when the McCloy standards were lower the average deviation between standards was 5.45 as against 3.27 when the Pryor standards were lower. For markedly underweight subjects the higher Pryor standards would probably be more nearly correct but in the slightly underweight, normal, and overweight groups the lower McCloy standards would seem to be more adequate.

TABLE 5

DISTRIBUTION OF McCLOY WEIGHT INDICES OF COLLEGE FRESHMAN GIRLS ACCORDING TO RESULTS OF A COMPARISON OF McCLOY AND PRYOR STANDARD WEIGHTS

Weight Index	McCloy Weight Higher	McCloy Weight Lower
115.01 and above (overweight)	0	3
108.00-115.00 (sl. overweight)	9	22
96.01-107.99 (normal)	49	100
96.00-94.00 (sl. underweight)	7	14
93.99 and below (underweight)	15	44
Totals	80	183

Value of McCloy Method

In the writer's opinion the McCloy method for determining normal weight warrants the time required to make the necessary measurements and calculations, since the standards are apparently more reliable than any at present available. It may be said, however, that the low correlation obtained between limb girth indices and nutrition estimates, indicates

that this index is not of sufficient value to warrant the expenditure of time required to secure it. In the majority of individuals the determination of the weight and fat indices provides the information necessary to determine whether or not there is a normal distribution of muscle and fat. The omission of the limb girth measurements would also simplify the procedure of taking the measurements, since children would not have to wear a one piece examining gown. With the omission of the thigh girth measurement, both girls and boys could wear trunks with an elastic top which could be slipped down over the hips. In addition, girls could wear a short cape around the shoulders.

Following are the measurements necessary for determining the weight and fat indices: standing height, weight, chest circumference at xiphoid level, bi-iliac hip width, knee width, fat-chest front, fat-chest back, fat-suprailiac, and fat-abdominal. The taking of these measurements requires about 8 minutes and about the same length of time is needed to make the necessary calculations of the two indices for each subject.

SUMMARY

The use of the McCloy method for the determination of normal weight in a 4-year study of grade-school children and in a group of college freshman girls has shown that the method gives results which appear reasonably accurate except in markedly overfat or emaciated individuals.[10]

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[10] *McCloy uses age at the last birthday. This is not stated in his publications.*

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AN ACOUSTICAL STUDY OF THE PITCH OF INFANT HUNGER WAILS

GRANT FAIRBANKS[1]

This paper reports an acoustical investigation of the pitch of experimentally induced hunger wails[2] produced by the author's male infant. In brief, the experimental situation was this: On the consecutive monthly birth dates for the first 9 months of life the regular 2 o'clock afternoon feeding period was withheld, the infant was brought into the recording laboratory and placed before the microphone. After wailing vocalization was approximately continuous, a condition which was reached between 15 minutes and 1½ hours after placement before the microphone, a 4 minute phonograph recording was cut. This recording was subjected to acoustical measurement.

The characteristics of the infant show him to have been a suitable subject for this type of experimentation. The delivery was full-term, normal and easy. The birth weight was 7½ pounds, which is approximately average for male infants in the Middlewest. According to a periodic series of anthropometric and psychological measurements made by the Child Welfare Research Station and the Department of Pediatrics at the State University of Iowa, which measurements will not be presented in detail, the infant grew and developed within the average range. He was breast-fed, had no digestive disturbances, and, in fact, no illnesses of any kind during the entire 9-months period of measurement. Of especial pertinence to this study is the fact that he rarely cried, and, in general, gave every superficial evidence of being an unusually comfortable and happy infant. It should be emphasized that on none of the 9 recording occasions was he wailing at the time of being brought into the laboratory.

Acoustical analysis of the pitch of the recorded hunger wails was accomplished by means of an instrument for phonophotography and fundamental frequency measurement from phonograph recordings, most recently described by Cowan (2). The over-all error of this method of frequency measurement is approximately 0.5 per cent, or 0.04 tone. Within each 4-minute recording, 6 equally spaced, 10-second intervals were photographed, supplying for measurement, thus, 60 seconds from each recording, a total of approximately 9 minutes for the entire period.[3]

I. RESULTS

Figure 1 presents graphs of frequency distributions of the pitches used. These are similar to conventional frequency polygons, except that

[1] *From the Department of Speech, State University of Iowa.*

[2] *No brief is held for the description of the vocalizations as "hunger wails," nor does it seem to be fruitful to speculate about the degree to which they reflected fear, anger, or any other affective state. The term is used to refer conveniently to the crying which occurred under the conditions described.*

[3] *The process of measurement is laborious, and, if these samples appear to be small, it may be mentioned that past studies of speech have customarily measured intervals of from 4 to 30 seconds in duration. As a matter of fact, the data reported above involved the individual consideration of more than 170,000 sound waves.*

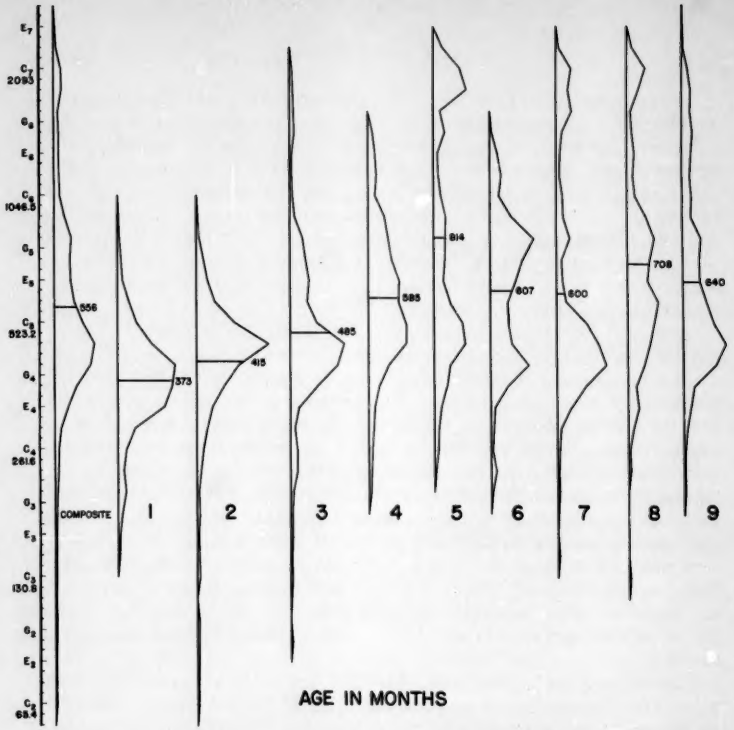

Figure 1. Frequency distributions of the pitches used.

the variable being measured is shown along the vertical axis which is the equal-tempered musical scale. The abscissa, in the case of each distribution, is percentage of cases, making the distributions mutually comparable as to shape. The means are indicated by horizontal lines. A composite distribution of all pitches measured during the entire 9-months period is shown at the left, while distributions for the consecutive monthly measurements comprise the balance of the figure. In Table 1 are presented the data computed from the distributions.

The major results of the study, which may be observed in Figure 1 and Table 1, fall into two divisions; 1) the general pitch characteristics of the wails; 2) changes in these characteristics during the time interval considered.

General Pitch Characteristics of the Hunger Wails

The mean of the composite distribution is seen to be 556 cycles per second. This is more than one octave higher than the central tendency of the average adult female speaking voice, and more than two octaves

TABLE 1

MEASUREMENTS OF FREQUENCY AND PITCH

	Composite	Age in Months								
		1	2	3	4	5	6	7	8	9
Mean (∿)	556	373	415	485	585	814	607	600	708	640
Lowest Frequency (∿)	63	153	63	89	214	229	206	150	134	207
Highest Frequency (∿)	2631	888	947	2120	1495	2387	1487	2348	2329	2631
Mean (tones + 16.35∿)	30.7	27.3	28.2	29.5	31.2	34.0	31.5	31.4	32.8	31.9
S. D. (tones)	4.6	2.3	3.1	3.7	3.3	5.7	3.3	5.5	4.7	4.3
Total Range (tones)	32.6	15.3	23.5	27.5	16.9	20.4	17.2	23.9	24.9	22.3
90% Range (tones)	15.8	8.2	9.0	12.2	11.3	16.1	10.3	15.8	16.0	14.0

higher than that of the average adult male.

The lowest frequency measured during the entire period was 63 c.p.s., approximately two octaves below middle C. Values this low are reasonably common in average adult male speech, and it is not unusual for concert basses to sustain such tones. In fact, some choral basses are reported to be capable of singing tones one octave lower. It is somewhat surprising, however, to discover frequencies of this order produced by an immature infant larynx. It should be pointed out that this is not one isolated measurement, but that the distribution is more or less continuous from the mean down (see Figure 1).

At the upper end of the distribution the highest frequency measured was 2631 c.p.s. This tone is approximately one octave higher than the top notes sung by such a coloratura soprano as Lily Pons in the Bell Song, the Quartet from Rigoletto, etc. Very few singers have been reported to be capable of singing tones of the frequency measured, more than 3 octaves above middle C.

These extreme values, encompassing, as has been shown, the lowest notes of the bass and the highest notes of the coloratura, provide a total range during the period of 32.6 musical tones, or somewhat in excess of 5 octaves. This may be compared to the maximum singing range of the adult, usually found to be in the neighborhood of 18 to 20 tones, or approximately 3 octaves, on the average.

Changes in the Pitch Characteristics of the Hunger Wails

Inspection of the monthly means in Figure 1 and Table 1 shows that there is a rapid and consistent rise throughout the first half of the period, followed by irregular but smaller changes thereafter, which form what might be termed a plateau at this higher level. It will be noted that these changes in central tendency cover the wide range of 6.7 tones, or more than one octave. The shape of the distributions is also seen to change. From a comparatively normal distribution at one month, the variability is seen to increase and the distributions to become more irregular. Again this change is rapid throughout the first half of the

period. Attention should be called to the rather prominent secondary peaks to be seen at the upper ends of the distributions during the last part of the period.

In order to assist visualization of the changes, four of the measures from Table 1 are graphed in Figure 2. The top curve of variations in the mean pitch level shows the positively accelerated rise followed by the plateau, features which have been described above. The second curve, that of the total pitch range, is seen to vary somewhat sporadically. Because this unreliable measure of variability is affected by a few isolated cases, the data plotted in the third curve were computed. This measure, which has been termed the "90 per cent pitch range," is, for any given sample, the range of pitch which subtends the median 90 per cent of the cases. In other words, it is the difference between the ninety-fifth and the fifth percentiles of the frequency distribution. The variations in this measure are seen to be more regular, and to be not dissimilar to the variations of the mean. The changes in the standard deviation, shown in the fourth curve, are observed to correspond even more closely to the variations of the mean.

In summary, the changes during the first 9 months were found to consist of 1) a large and rapid rise in the central tendency of the pitches used during the first half of the period, followed by a more or less consistently high level thereafter; 2) concomitant changes in pitch variability.

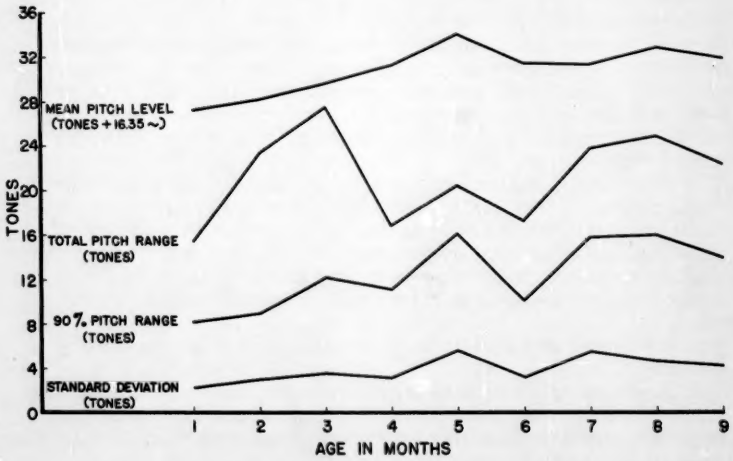

Figure 2. Variations in pitch characteristics during the nine-months period. A: Mean pitch level in tones above 16.35 c.p.s. B: Total pitch range in tones. C: 90 per cent pitch range in tones. D: Standard deviation in tones.

II. DISCUSSION

The available data afford no basis for the restrictive selection of any single factor, or group of factors, as responsible for these changes in the hunger wails. It is known that the growth of the larynx during the first year of life is normally very rapid, probably more rapid than during any other post-natal year, with the possible exception of the fifteenth in the male. There is no reason to believe that the subject of the present study is markedly different from the average infant in this respect. Presumably a feature of the laryngeal growth is an increase in the length and thickness of the vocal folds, a change which accompanies normal pre-adult growth. Differences in these respects also distinguish male from female larynges and are the major factors in the vocal pitch differences between the sexes. Since, other variables constant, increases in length and thickness lower the natural frequency of a vibrator, a progressive lowering of the pitch level, as in the case of the change from childhood to maturity, might be expected. Instead, as has been shown above, the change in the central tendency of the hunger wails was generally upward during the first half of the period. In other words, the direction of the observed change in pitch level was inconsistent with the presumed change in length and thickness of the vocal folds. As has been suggested, length and thickness probably determined, or at least limited, the general pitch level of the entire period; since presumably they changed rapidly, their influence may not be overlooked in an explanation of the vocal changes during the period. However, in view of this inconsistency, it seems reasonable to conclude, by elimination, that the observed change in pitch level was primarily a function of variation in vocal fold tension rather than of variation in length and thickness.

If this analysis be accepted, then a progressive increase in the tension of the laryngeal musculature during the first half of the period may be inferred and requires explanation. This increase might be related to certain psychological conditions. Such conditions constant, however, it might reflect simply an increase in the capacity to exert muscular tension in and adjacent to the larynx. This suggestion would be consistent with the fact that the average infant undergoes very rapid neuro-muscular development during the first half year of life, and it would provide an explanation for the rise in pitch during the first 5 months. It is not necessarily incompatible with the approximate plateau during the balance of the 9-months period. The latter might be interpreted to result from marked negative acceleration of neuro-muscular development (which is believed to occur at about that age) coincident with less negatively accelerated continuation of dimensional growth. In a like manner the changes in pitch variability may be explained.

Nevertheless, it would be difficult to defend an exclusively growth-and-development interpretation. It may have been observed that the curves depicting the pitch changes are remarkably similar to previous plottings of data secured during the establishment of conditioned responses. This similarity does not prove, per se, that a process of conditioning or learning was going on. In the light of what is known of infant behavior, however, it is not unreasonable to suggest this as a

possibility. One measure of the goodness of conditioning is the magnitude, amplitude or vigor of the response. Anrep (1), for example, measured the amount of salivary flow per unit of time, while Hilgard and Marquis (4) and Hilgard and Campbell (3) recorded the amplitude of reflex eyelid movement. The measurements made in the present study may be considered comparable in the field of vocal response.[4] Making allowance for variations in drive (e.g., hunger), and for the fact that one subject only was studied, the changes in vocal pitch are such as would be predicted on a conditioning or learning hypothesis. It may be added that conditioning phenomena, if present, do not, of course, preclude such concurrent operation of other variables as has been discussed above.

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[4] *Vocal intensity might have been an even better measure of the vigor of a vocal response, but the available recording equipment was incapable of handling the extreme intensity range.*

Contents for September

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